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Growth, Inequality and Simulated Poverty Paths for Tanzania, 1992-2002

Gabriel Demombynes and Johannes G. Hoogeveen*

Abstract – Although Tanzania experienced relatively rapid growth in per capita GDP in the 1995-2001 period, household budget survey (HBS) data shows only a modest and statistically insignificant decline in poverty between 1992 and 2001. To assess the likely trajectory of poverty rates over the course of the period, changes in poverty are simulated using unit-record HBS data and national accounts growth rates under varying assumptions for growth rates and inequality changes. To this end the projection approach of Datt and Walker (2002) is used along with an extension that is better suited to taking into account distributional changes observed between the two household surveys. The simulations suggest that following increases in poverty during the economic slowdown of the early 1990s, recent growth in Tanzania has brought a decline in poverty, particularly in urban areas. Unless recent growth is sustained, the country will not meet its 2015 Millennium Development Goal (MDG). Poverty reduction is on track in urban areas, but reaching the MDG target for bringing down poverty in rural areas, where most Tanzanians live, requires sustaining high growth in rural output per capita.

* Demombynes is a consultant to the World Bank. Hoogeveen is with the World Bank. Please send correspondence to both gabriel@demog.berkeley.edu and jhoogeveen@worldbank.org.

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1 Introduction

Following a period of economic stagnation in the early 1990s, Tanzania has seen sustained gains in per capita output since 1995. The 2000/01 Household Budget Survey (HBS) offers the opportunity to assess how economic growth at the national level has impacted household consumption and poverty levels since the 1991/92 HBS. At the national level, the two surveys show only a small and statistically insignificant decline in the headcount rate. This fact, combined with the relatively rapid growth of recent years, has raised concerns that recent economic growth may not be substantially reducing poverty.

The survey data, however, provides only two snapshots in time and fails to represent the full evolution of poverty over the course of the intervening nine years. The primary purpose of this paper is to assess the likely trajectory of poverty rates over the full span of the period between the surveys. This is done by applying macroeconomic growth data to the micro-level household survey data. Changes in consumption are simulated year-by-year using unit-record survey data, under varying assumptions for growth rates and inequality changes. The growth data is drawn from national accounts statistics. The analysis follows the procedure outlined in Datt and Walker (2002) and Datt et al. (2003).

The paper also implements an extension to the Datt and Walker method. The original procedure was designed to project poverty rates forward from a single survey. When the task is to estimate the trajectory of poverty rates during the period between two surveys, as with Tanzania for the 1990s, an alternative method can be used. The method involves scaling national accounts growth rates for multiple parts of the distribution. Unlike the Datt and Walker method, this approach guarantees that the simulated distribution will closely match the distribution in the final survey year.

The paper is structured as follows. Section 2 describes the data sources, key findings from the Tanzania Household Budget Survey report, and issues surrounding the data. Section 3 presents some poverty and growth diagnostics: a decomposition of growth and inequality, a sectoral decomposition of poverty changes, and growth incidence curves. Section 4 outlines the simulation methodology—both the Datt and Walker method and the alternative approach. Section 5 presents the simulation analysis. The section investigates different assumptions regarding the data and the method of simulation. Our preferred scenario is presented in Section 5.7 after which Section 5.8 considers the main assumption underlying the Datt-Walker approach: that economic growth translates into higher consumption for all population groups. This is done by investigating whether since 1994, and for given GDP growth, inequality changed rather than that poverty dropped. Section 5.9 presents MDG projections, and Section 6 concludes.

2 Data Sources

2.1 Household Budget Surveys

The primary sources of poverty data for Tanzania are the Household Budget Surveys conducted in 1991/92 and 2000/01. Basic poverty statistics calculated from the survey data are shown in Table 1. In Tanzania[1] as a whole, in rural areas, and in urban areas other than the capital, the household survey data shows a statistically insignificant growth in consumption per adult equivalent of 6.4%, with small and insignificant drops in the fraction living in poverty, and no

[1] When we refer in this paper to Tanzania as a whole we only refer to mainland Tanzania, i.e. the United Republic of Tanzania, excluding Zanzibar.

change in inequality. In Dar es Salaam, per capita consumption increased by 43%, headcount poverty dropped by a third, and inequality as measured by the Gini coefficient jumped from 0.30 to 0.34. All the changes in Dar are significant at the 95% confidence level.

Table 1: Consumption Data from Household Budget Survey Data

	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
% Below Basic Needs Pov. Line				
1991/92	38.6	28.1	28.7	40.8
	(2.1)	(2.8)	(5.0)	(2.4)
2000/01	35.6	17.6	25.8	38.6
	(1.6)	(2.7)	(2.2)	(2.0)
Consumption per Adult Equivalent				
Mean, 1991/92	10223	11161	12445	9820
	(290)	(410)	(842)	(326)
Mean, 2000/01	10880	15944	13536	10060
	(250)	(779)	(487)	(273)
Ratio (00/01) to (91/92)	1.064	1.429	1.088	1.024
Gini Coefficient				
1991/92	0.33	0.30	0.34	0.33
	(0.01)	(0.01)	(0.02)	(0.02)
2000/01	0.34	0.34	0.35	0.32
	(0.01)	(0.01)	(0.01)	(0.01)

Notes: All figures shown are as calculated from Household Budget Survey data. Standard errors are given in parentheses. All figures were calculated from household-level data on a per adult equivalent basis, with weights calculated by multiplying household size by household sampling weights. 1991/92 figures were converted to 2000/01 Shillings by multiplying by 2.611811, which is the ratio of the poverty lines used to calculate the poverty levels, using nominal values in the official poverty report.

The poverty statistics calculated for this paper differ slightly from those in the official published report, *Household Budget Survey 2000/01* (United Republic of Tanzania, National Bureau of Statistics, 2002). These are reproduced in Appendix Table 1. While the headcount rate figures are identical to those that were calculated for this paper, the published mean consumption figures differ slightly from those calculated for Table 1. This is partially because the published figures were calculated on a per capita (rather than per adult equivalent) basis.[2]

[2] Also, for this analysis, the 1991/92 survey figures were converted to 2001/02 Shilling figures by multiplying by 2.611811, the ratio of the (Basic Needs) poverty lines from the two years. In the official figures, a price adjustment of 2.49 was used. The official figures and the analysis here also employ regional price adjustments. This combination of price adjustments may have been implemented differently for the official mean consumption figures than is done here. The report indicates explicitly that the mean consumption figures were calculated on a per capita basis, rather than the

There are three caveats associated with the figures for Dar es Salaam. First, the HBS report says "Note that there is some evidence that consumption expenditure was under-reported in Dar es Salaam in the 1991/92 HBS. This would mean that poverty levels may in fact have been slightly lower in 1991/92 and the decline smaller …. Although [an earlier report] attempted to adjust for this under-reporting in the 1991/92 data, this was not repeated in this analysis as it was difficult to assess its accuracy" (p. 80, footnote 21).

A second concern stems from the fact that both the 1991/92 and 2000/01 surveys used a sampling frame based on the 1988 national population census. Between 1988 and 2002, the population of Dar es Salaam grew extremely rapidly, at an annual growth rate of 4.4 percent, for a cumulative increase of 84 percent. Given such a high rate of population growth, it is possible that by the time of the second HBS survey, the true geographic distribution of the population differed substantially from that in the census-based sampling frame. In particular, it is likely that new settlements were created in areas of the city that were not populated or only sparsely populated in 1988. Consequently, households in such areas might not have been included in the survey sampling frame, or included with only a very low sampling probability. If households in new settlements are poorer than average households in the city then the drift of the population from the 1988 sampling frame biases the 2000/01 poverty figures downward from their true values. Both this phenomenon and the possible underreporting of consumption in the 1991/92 HBS imply that the drop in poverty in Dar es Salaam may not have been as steep as it appears in the survey data.[3]

Finally, a related weighting issue has implications for the national poverty figures. Because the 2000/01 survey sampling frame was based on the 1988 census, the sampling weights understate the relative weight of areas like Dar es Salaam that experienced rapid population growth. The overall effect of this phenomenon is small. Poverty calculations done after reweighting the survey data to reflect the regional population distribution in the 2002 census show estimated national poverty incidence to be 35.3%, versus 35.6% using the original weights. This difference can be attributed entirely to the greater weight accorded Dar es Salaam with the revised weights. Using population estimates from the 2002 census, 7.4% of the population lives in Dar es Salaam as opposed to 5.8% when population numbers from the 1988 census are used. The difference between the estimates is not due to changes in poverty incidence within the three strata. Reweighting has no effect on poverty estimates for Dar es Salaam and rural areas as a whole, and in other urban areas it increases the estimate negligibly, from 25.8% to 25.9%. To maintain comparability with the official poverty statistics, in the remainder of the paper we calculate poverty rates using the official (non-reweighted) sampling weights. Only in section 3.2, table 4, where we decompose changes in poverty into changes by sector and population shifts across sectors, do we make use of reweighted survey weights.

2.2 National Accounts

The other main source of economic information for Tanzania is the national accounts information, tabulated in the *Economic Survey 2002* (United Republic of Tanzania, Office of the President, 2002). Key data drawn from the report is shown in Table 2.

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adult equivalent basis used for the poverty figures. It is also possible that a slightly different consumption aggregate than that employed here was used to calculate mean consumption.

[3] It would be possible to examine the sampling frame issue in more detail by comparing the distributions of household characteristics in the 2002 census and the 2000/01 survey for Dar es Salaam. If the distributions match closely, drift in the sampling frame is unlikely to have had a large effect on the poverty figures. If the distributions do not match, the problem could be addressed by reweighting the survey data to match the distribution of characteristics in the census data. The issue of reweighting for Dar es Salaam will be addressed as part of the ongoing poverty mapping project.

Several points are evident from the national account data. First, during the period between the household surveys (taken as 1993-2001), cumulative growth in per capita GDP was only 6.1%, despite the sustained gains during the final years of the period. This is because the country faced substantial declines in per capita output at the beginning of the period. Second, output in the urban sector grew slightly more rapidly than in the rural sector over the full span of the period, and at the end of the period, urban growth substantially outpaced rural growth. Third, year-to-year growth rates in household consumption per capita differed from those for GDP per capita, but overall growth in household per capita consumption for the period was just slightly greater, at 8.3%.

Table 2: Growth Data from National Accounts

Year	GDP Growth Rate	Per Capita GDP Growth	Per Capita Rural Growth (monetary + non-monetary agriculture)	Per Capita Urban Growth (all non-agriculture)	Hhold. Cons. as Fraction of GDP	Implicit GDP Price Deflator	Growth Rate of Per Capita Hhold. Cons.
1990	6.2%	3.3%			0.90	0.62	
1991	2.8%	-0.1%	0.7%	-0.9%	0.90	0.79	-1.0%
1992	1.8%	-1.1%	-1.7%	-0.5%	0.89	1	-2.0%
1993	0.4%	-2.5%	0.2%	-5.0%	0.90	1.26	-1.3%
1994	1.4%	-1.5%	-0.8%	-2.2%	0.91	1.64	-0.4%
1995	3.6%	0.7%	2.9%	-1.6%	0.91	2.08	0.3%
1996	4.2%	1.3%	1.0%	1.6%	0.91	2.46	1.4%
1997	3.3%	0.4%	-0.5%	1.3%	0.93	2.96	2.5%
1998	4.0%	1.1%	-1.0%	3.2%	0.96	3.40	4.6%
1999	4.7%	1.8%	1.2%	2.4%	0.95	3.79	0.8%
2000	4.9%	2.0%	0.5%	3.4%	0.91	4.05	-2.6%
2001	5.7%	2.8%	2.6%	3.1%	0.91	4.36	2.9%
2002	6.2%	3.3%	2.1%	4.4%	0.87	4.65	-0.9%
1993-2001: Average growth rate	3.6%	0.7%	0.7%	0.7%			0.9%
Cumulative change	37.1%	6.1%	6.2%	6.0%			8.3%

Source: *Economic Survey 2002, United Republic of Tanzania*
Notes: This paper examines growth between the years 1992 and 2001, which is calculated as the cumulative effect of growth rates for the years 1993-2001. GDP growth figures are taken from Table 4A, p.16. Per capita GDP growth rates were calculated by subtracting 2.9%, the average population growth rate between the 1988 and 2002 censuses. Household consumption as a fraction of GDP was calculated from figures in Table 2B, using GDP at factor cost prices. The implicit GDP price deflator was calculated by dividing nominal GDP at factor cost prices (Table 2B) by GDP in 1992 prices (Table 3).
Separate rural and urban per capita growth rates were calculated using the growth rate and economic composition figures by sector and the national rate of population increase (this latter assumption is relaxed in Section 5.4). Because rural non-agricultural output is not separately identified in the national accounts, the rural GDP growth rate figures are based on the agriculture sector alone (monetary and non-monetary) and do not include growth in the non-agricultural sector. A substantial fraction of income in the rural area is earned from non-farm sources. According to the HBS report (Table 9.2), the principal sources of rural income are: 60.4% from agriculture, 17.8% from non-farm self employment, 8.3% from employment, and 12.8% from transfers and other receipts. During the period of study, growth in the non-agricultural sector exceeded growth in the agricultural sector but only by 0.1% point so that rural growth may be only slightly underestimated.

3 Poverty and Growth Diagnostics

3.1 Decomposition Analysis of Growth and Inequality

A useful way to take a first look at the impact of growth on poverty is by decomposing the change in the headcount rate. In general, a change in poverty can be attributed to the interaction of two processes -- growth in mean consumption and a change in consumption inequality. The formal decomposition proposed by Datt and Ravallion (1992) attributes changes in poverty to a growth effect, an inequality effect, and an interaction effect (the residual).

Results from this decomposition applied to the Tanzania data are shown in Table 3. The decomposition shows that overall growth reduced poverty in the country as whole by 4.6 percentage points. The slight increase in inequality, however, increased poverty by 1.1 percentage points. The same general pattern holds for rural areas and urban areas other than Dar es Salaam.

The results are more notable for Dar, where the substantial decline in poverty was attributable to the city's economic growth. Holding inequality constant, growth reduced poverty by 16.3 percentage points. The growth-induced decline in poverty was partially countered by increasing inequality, which drove up poverty by 9.8 percentage points.

Table 3: Growth and Inequality Poverty Decomposition

	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
Poverty Rate in 1991/92	38.6	28.1	28.7	40.8
Poverty Rate in 2000/01	35.6	17.6	25.8	38.6
Change in Poverty	-3.0	-10.5	-2.9	-2.2
Breakdown in levels				
Growth Component	-4.6	-16.3	-4.4	-2.6
Redistribution Component	1.1	9.8	1.5	-0.4
Residual	0.6	-4.0	0.0	0.9
Breakdown in percentages				
Growth Component	155%	156%	154%	119%
Redistribution Component	-35%	-93%	-53%	20%
Residual	-20%	38%	-1%	-39%

Notes: Decompositions were calculated using the approach of Datt and Ravallion (1992). The analysis shown here uses 1991/92 as the base year for the decomposition.

3.2 Sectoral Decomposition of Changes in Poverty

Another way to break down the overall change in poverty is by considering the contribution of changes in poverty in each sector to the national change. Following Huppi and Ravallion (1991), the national change in the headcount rate can be attributed to a combination of changes within each sector and shifts in population between sectors. There is also a small portion of the change that is due to an interaction effect between intra-sector changes and population shifts.

Results from a decomposition for Tanzania are shown in Table 4. A somewhat surprising point is that while poverty declined much more in Dar es Salaam (from 28.1 to 17.6 percent), most of the small drop in the national poverty rate was due to a modest decline in poverty in rural areas.

This is due to the fact that only a small fraction of the population lives in Dar.[4] Consequently, even the large drop in poverty in Dar made only a small dent in the national poverty rate, while the small drop in the rural poverty rate had a relatively large effect on the national poverty rate.

The decomposition also shows that just 11.6 percent of the decline in the headcount at the national level is attributable to the shift of the population from poorer rural areas to wealthier urban areas, chiefly Dar es Salaam. Most of this shift is probably due to migration. The small size of this "population-shift effect" demonstrates that rural-urban migration cannot substantially reduce poverty in Tanzania in the short run. Because the population is overwhelmingly rural, even the rapid shift of population to wealthier Dar, which saw its population grow at a 4.4 percent annual rate versus 2.9 percent for the country as a whole, did not substantially reduce the national poverty rate.

Table 4: Sectoral Decomposition of the Change in Poverty

		Contribution to Change in National Headcount Rate	
	Population Share in 1991/92	Absolute Change	Percentage of Total Change
Dar es Salaam	5.35	-0.56	17.08
Other Urban Areas	12.6	-0.34	10.49
Rural Areas	82.06	-1.82	55.41
Total Intra-sector Change		-2.72	82.98
Population-Shift Effect		-0.38	11.60
Interaction Effect		-0.18	5.41
Change in Poverty		-3.28	100

The sectoral decomposition was calculated using both the 1991/92 and 2000/01 HBS data. For this analysis, in order to ensure that the decomposition properly accounted for changes in population shares, the 2000/01 data was reweighted to reflect the regional population distribution reported in the 2002 national census. As a result, the decline in the headcount rate shown here, 3.28, is slightly greater than the decline of 3.0 shown in Table 1 (from 38.6 to 35.6), based on calculations using the original weights.

Altogether, 55 percent of poverty reduction nationally was attributable to poverty declines in rural areas, and 39 percent was due to population shifts and declines in urban areas, with the remainder accounted for by the interaction effect. What does this suggest about the potential sources of poverty reduction for Tanzania in the future? Because both urban poverty reduction and urban-rural migration were already rapid during the 1990s, it is very unlikely that either can be an *increased* source of poverty reduction in the near future. This is especially the case because the headcount rate in Dar is now low enough, at 17.6%, that the potential for reducing it further is limited. Consequently, accelerating the rate of decline of poverty can only be accomplished by increasing poverty reduction in rural areas. While migration and urban growth can play secondary

[4] Table 4 shows 5.35 of the population percent living in Dar. This figure is based on the weights in the 1991/92 HBS. Census data, which provides more definitive population information, show that the fraction living in Dar was 5.8 percent in 1988 and 7.4 percent in 2002.

roles, much more than 55 percent of poverty reduction will have to come from rural growth if Tanzania is to make substantial progress in bringing down poverty for the nation as a whole.

3.3 Growth Incidence Curves

The impact of growth on poverty can be examined graphically through a growth incidence curve (GIC), which illustrates the distribution of growth. A GIC is a plot of the growth rate for each quantile of the distribution of per adult equivalent consumption. Growth incidence curves for the nation as a whole and the three strata are shown in Figure 1. The curves were constructed based on the two household surveys, and the annual growth rates reflect average changes over the 1993-2001 period. The growth incidence curves were generated by splitting the distributions into 15 quantiles or bins.

Although the vertical scale is the same across the different curves, the horizontal scale plots percentiles within each sector, so points at the same percentile level for different sectors correspond to different levels of consumption. The vertical line in the graph indicates the poverty headcount index in 1992, while the horizontal line denotes the mean overall growth rate.

We consider growth "absolutely pro-poor" if the mean growth rate for the poor is greater than zero and "relatively pro-poor" if, in addition, the mean growth rate for the poor is at least as large as the growth rate in the overall mean. Hence, "absolute pro-poor growth" only requires that the poor be better off on average in absolute terms, while "relative pro-poor growth" requires the distributional shifts to be pro-poor as well.

In terms of Tanzania as a whole, the growth incidence curve lies entirely above zero, implying that consumption increased at every point in the distribution. In other words, growth for the country as a whole was pro-poor in absolute terms. Likewise, growth was absolutely pro-poor in Dar es Salaam and rural areas. Although mean growth rates were modest everywhere except Dar, growth did improve consumption for rich and poor alike. Only in the distribution for the other urban areas stratum were there absolute declines, in the poorest percentiles.

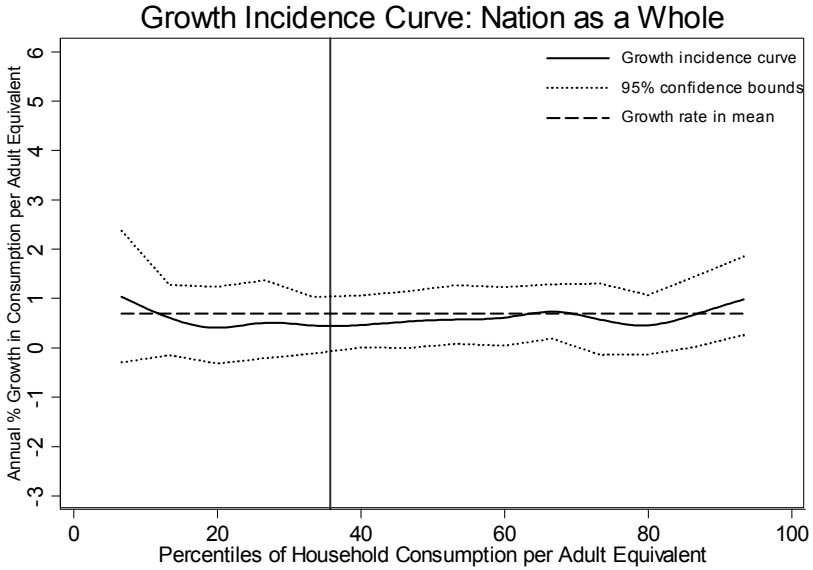
In Dar es Salaam and other urban areas mean growth rates for the poor were below growth in the mean for the stratum as a whole and growth was not relatively pro-poor. In rural areas, however, growth was relatively pro-poor as the modest amount of growth that did take place was concentrated among the poorest. In rural areas the rate of growth among the poor averaged 0.5% per year, versus mean growth of 0.3% for rural areas overall. This mixed picture for rural and urban areas means that for the nation as a whole the mean growth rate for those who were poor in 1991/92 is 0.6%, just below the growth rate in the mean of 0.7%.

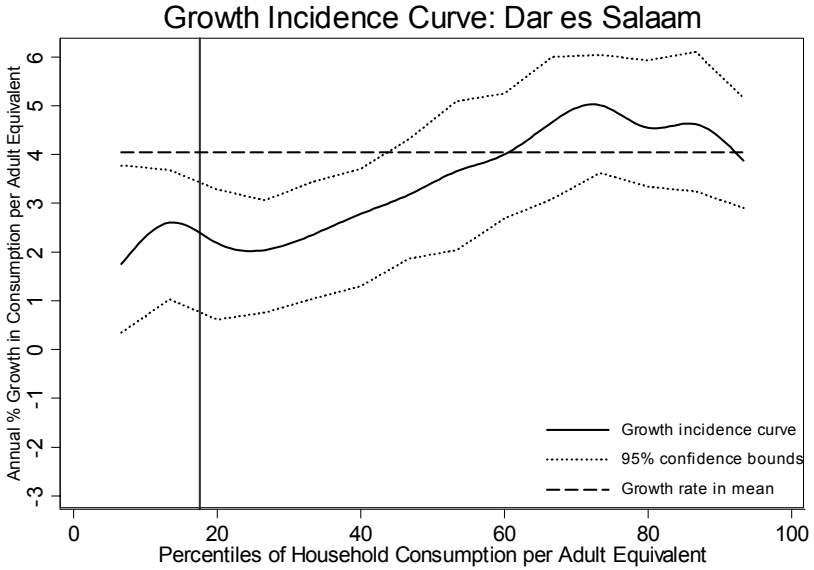
Another way to view the curves is to recognize that a GIC that is upward sloping implies that the poor benefit from growth less than the non-poor, leading to an increase in inequality. The curves for Tanzania show that urban areas, which experienced the greatest gains, also saw increases in inequality.

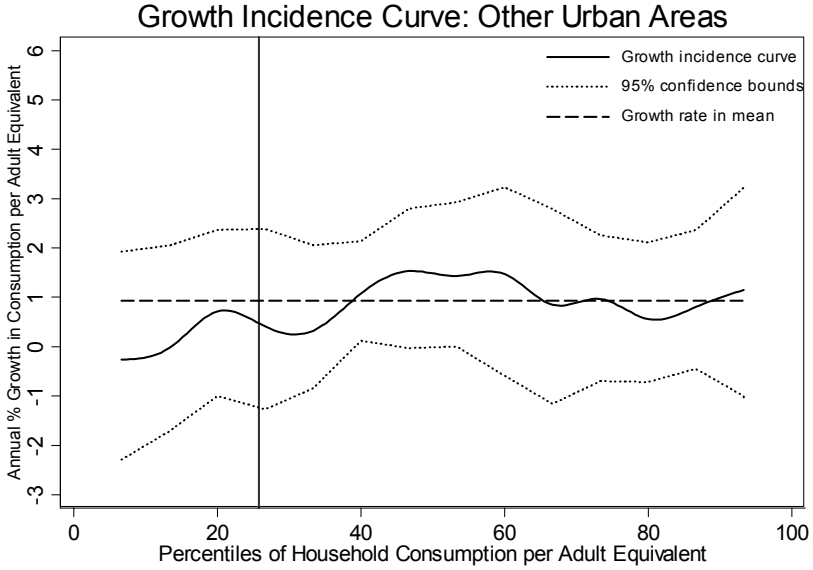
It should be noted that given the size of the confidence intervals on the curves, small differences between growth rates shown on the curve are not statistically significant. Additionally, for rural areas, other urban areas, and the nation as a whole, we cannot reject the hypothesis that the curves are flat, i.e. that the impact of growth is evenly distributed. The greater rate of growth for non-poor households in urban areas, however, is statistically significant.

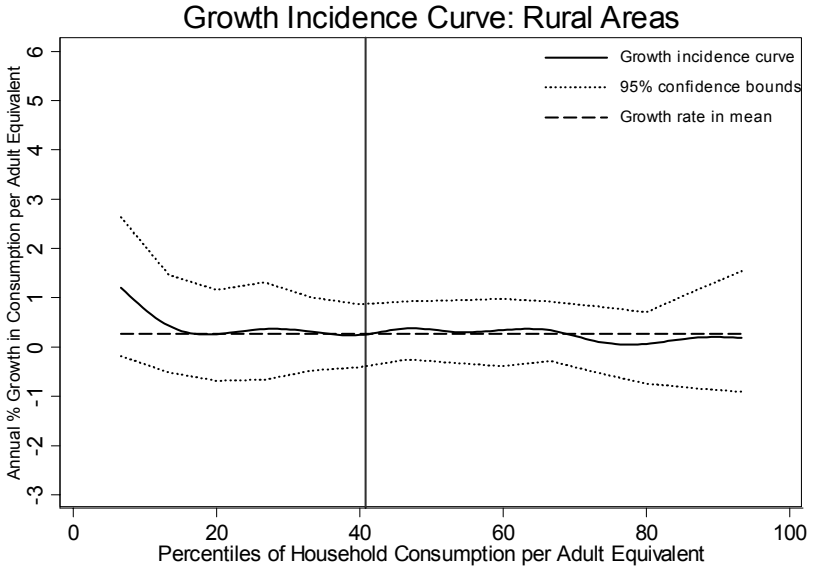
In summary, the curves show that growth has had widely different distributional impacts by sector. As the large majority of people live in rural areas, the national growth incidence curve resembles the growth incidence curve for rural areas, showing equally distributed, limited, growth with some relative gains for the poorest.

Figure 1
Growth Incidence Curves









4 Poverty Simulation Methodology

4.1 Basic Approach

This section briefly sketches the approach used in the main part of the analysis. A fuller treatment is given in Appendix 1 of Datt and Walker (2002) and in Datt et al. (2003). The general approach is to simulate changes in consumption by applying annual GDP per capita growth rates to unit-record household survey data. For this application, consumption is defined in per adult equivalent terms. Allowance can be made for varying population and GDP growth rates at the sectoral/regional level. The simplest version assumes that growth is distribution neutral, i.e. that inequality is unchanged. Alternatively, we can incorporate estimates of changes in inequality levels in the simulation.

The discussion presented here is done going forwards from the 1991/92 survey data. It is also possible to project the simulations backwards from the 2000/01 survey. Except for one case included in the appendix, the simulations conducted for this paper are done going forwards.

Notation

Define the following terms for a sample of *n* households:

- $c_{i,t}$ is per adult equivalent consumption for sample household *i* in year *t*, where *t=0* represents the survey year
- $w_{i,t}$ is the individual weight for household *i* in year *t*. These weights are the product of the household sampling weights (the inverse of the probability of selection of the household in the survey) and household size.
- the sector (or, alternatively, region) of household *i* in the survey year is given by $s_{i,t}$. This is assumed fixed over time, but we do allow for population shifts across sectors.
- $g_t^{S_i}$ is the real GDP growth rate for the sector of household *i* in year *t*.
- $\eta_t^{S_i}$ is the population growth rate for the sector of household *i* in year *t*.

Basic projections

The basic form of the projections is to calculate per adult equivalent consumption recursively,

$$c_{i,t} = c_{i,t-1}(1 + g_t^{S_i} - \eta_t^{S_i}), \quad (1)$$

while adjusting the weights for population changes year-by-year:

$$w_{i,t} = w_{i,t-1}(1 + \eta_t^{S_i}). \quad (2)$$

Note that in the consumption equation, the growth rate of consumption per *adult equivalent* is implicitly approximated as being equal to the growth rate of GDP per *capita.* [5]

Inequality adjustment

The assumption of distribution-neutral growth can be relaxed by adjusting consumption for each household within each sector year-by-year. This adjustment is made after the growth projection for each year. Take the percentage change in the Gini coefficient in sector S_i in year t as ΔG_t^S. The adjusted level of per capita consumption for household i is then

$$(3) \qquad c_{i,t}^{ADJ} = c_{i,t} - \Delta G_t^S (\bar{c}^{S_i} - c_{i,t}).$$

This produces a proportional shift in the sectoral Lorenz curve by adjusting consumption for each household relative to its deviation from the sector-specific mean. Note that the mean here is necessarily the weighted mean, calculated with the weights given by $\{w_{i,t}\}$. This adjustment effectively redistributes consumption from households below the mean to those above the mean (for an increase in the Gini), while leaving mean consumption by sector constant. It would be possible to undertake alternative redistribution procedures that would achieve the same outcome in terms of changes to the Gini and the mean.

4.2 Two Survey Approach

The Datt and Walker approach outlined above was designed to project changes in poverty based on national growth data and a single household survey, in the absence of data from multiple household surveys. For the analysis constructed in this paper, the problem is somewhat different, as the goal is to understand changes in the distribution during the period between two household surveys. While in the Datt and Walker general case the distribution of consumption is known only at the beginning of the simulated period, for Tanzania in the 1990s the full distribution is known both at the beginning and the end of the period.[6] An extension of the Datt and Walker method can be used to force the distribution at the end of the simulation to closely match that of the survey data. Specifically, extend the notation from above to reference each household's quantile, with n the number of fractions in which the distribution is broken down. For instance if n equals five, the distribution would broken down in quintiles.

- $g_t^{S_i,Q_i}$ is the real GDP growth rate for the quantile and sector of household i in year t.
- $\eta_t^{S_i,Q_i}$ is the population growth rate for the quantile and sector of household i in year t.

These quantiles are defined over individuals by household consumption per adult equivalent and can be in terms of the full national distribution, or in terms of each sector's distribution. The simulation is carried out using these growth rates:

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[5] In fact, the 2002 Census report shows that children made up a slightly smaller percentage of the total population in 2002 as they did in 1988. This means that the growth rate of consumption per adult equivalent was slightly larger than the growth rate of consumption per capita.

[6] More precisely, *estimates* of the distribution are known from the household surveys.

(4) $$c_{i,t} = c_{i,t-1}(1 + g_t^{S_i,Q_i} - \eta_t^{S_i}).$$

Because these year-by-year sector-quantile growth rates are not directly observed, estimates must be used. What is observed (via survey-based estimates) is each sector-quantile's cumulative growth in mean household consumption per adult equivalent between the two surveys. This is simply

(5) $$G^{S,Q} = \frac{\bar{c}_T^{S,Q}}{\bar{c}_{T_0}^{S,Q}} - 1,$$

where $\bar{c}_t^{S,Q}$ is the mean of household consumption per adult equivalent in year *t,* and T_0 and T are the initial and final years, respectively.

One way to estimate year-by-year sector-quantile growth rates would be to assume constant growth over time within each sector-quantile. The preferred approach, in the spirit of Datt and Walker, is to scale the national accounts year-by-year growth rates by the sector-quantile growth rates. To see how these can be calculated, note that cumulative growth in GDP per capita in the national accounts is simply the product of the series of annual growth rates:

(6) $$(1 + G^*) = \prod_{t=T_0+1}^{T} (1 + g_t^* - \eta_t^*) \ .$$

An asterisk is used here to refer to overall growth versus growth in particular sector-quantile. Note that the first year for which the growth rate is applied is not the initial year but the following year. Multiply both sides of that equation by $(1 + G^{S,Q})$:

(7) $$(1 + G^{S,Q})(1 + G^*) = (1 + G^{S,Q}) \prod_{t=T_0+1}^{T} (1 + g_t^* - \eta_t^*)$$

We carry out a series of algebraic manipulations to find the series of scaled growth rates by sector and quantile:

(8) $$1 + G^{S,Q} = \frac{(1 + G^{S,Q})}{(1 + G^*)} \prod_{t=T_0+1}^{T} (1 + g_t^* - \eta_t^*)$$

(9)

(10) $$1 + G^{S,Q} = \prod_{t=T_0+1}^{T} \left(\frac{(1 + G^{S,Q})}{(1 + G^*)} \right)^{1/(T-T_0)} (1 + g_t^* - \eta_t^*)$$

(11) $$1 + G^{S,Q} = \prod_{t=T_0+1}^{T} \left\{ 1 + \left[\left(\frac{(1 + G^{S,Q})}{(1 + G^*)} \right)^{1/(T-T_0)} (1 + g_t^* - \eta_t^*) - 1 \right] \right\}$$

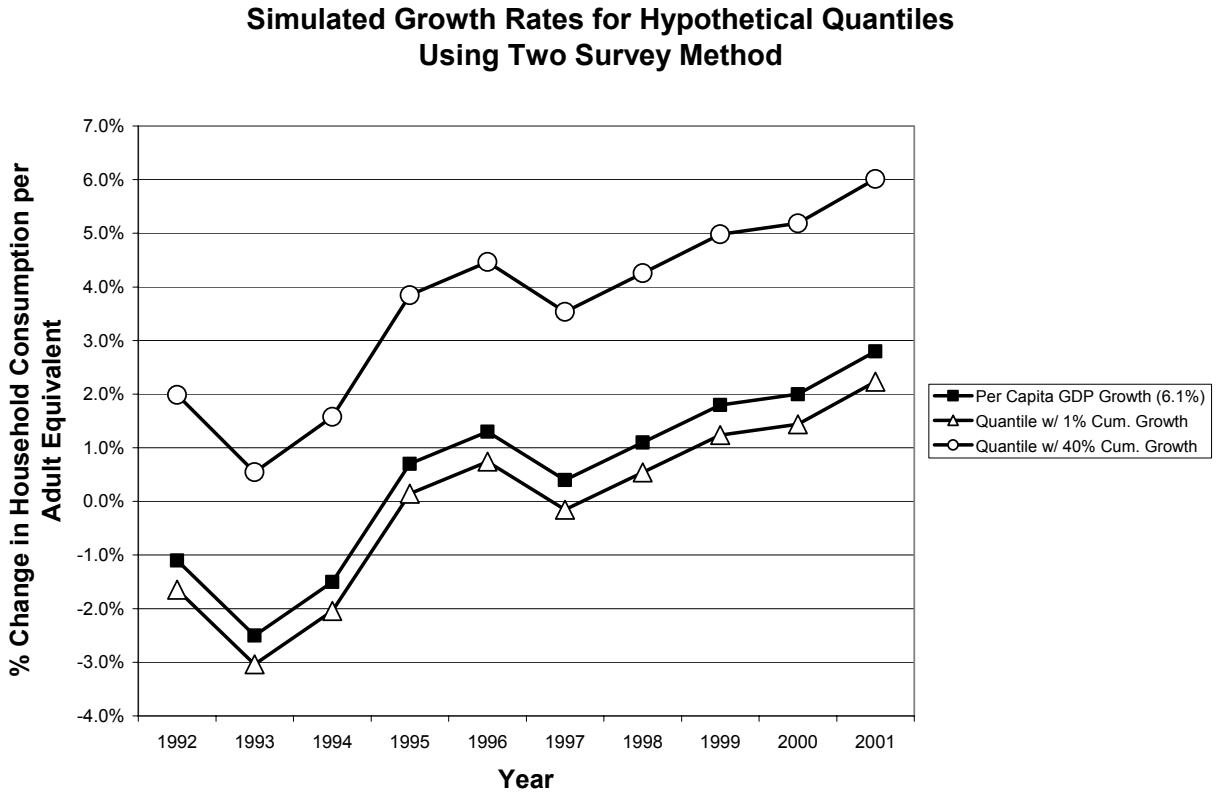
Equation (11), with a structure parallel to that of equation (6), implies a series of year-by-year growth rates for sector S and quantile Q that results in cumulative growth equal to $G^{S,Q}$. The effect

is to scale the year-by-year growth rates from the national accounts for each sector-quantile such that they cumulatively produce the growth observed in the survey for that sector-quantile. When year-by-year growth rates calculated this way by sector and quantile are applied in the simulation, starting with the initial year survey data, they should produce a distribution in the final year which closely matches the final year survey data.

In these simulations, each quantile's mean household consumption moves proportionally with the GDP per capita in the national accounts. This procedure is the natural extension of the inequality adjustment Datt and Walker apply in one version of their method. In the approach outlined here, rather than adjust the distribution to generate a specified change in a single inequality measure, we set the growth rates quantile-by-quantile to produce a particular distribution in the final year.[7]

This procedure is approximately (though not exactly) equivalent to setting the growth rates for individual quantiles by shifting the national growth rate pattern up or down. To illustrate this, in Figure 2 below, the true growth rates for Tanzania from the national accounts are plotted along with growth rates calculated using the procedure for two hypothetical quantiles with cumulative growth of 1% and 40%. Recall from Table 2 that cumulative GDP per capita growth 1993-2001 in Tanzania was 6.1%.

Figure 2



Note that the initial and final years of the simulation will match the "true" distributions in the survey data, and consequently the simulation's cumulative change in mean consumption will match the change implied by the survey data. If cumulative growth in GDP per capita differs from

[7] The "two survey" approach has a natural relationship to growth incidence curves: the simulations scale growth for each quantile to match the average growth rates that are plotted in the GICs.

cumulative consumption growth in the survey data, the simulated year-by-year changes in mean consumption will not be equal to the year-by-year GDP per capita changes. In Tanzania, the cumulative GDP per capita growth (6.1%) is close to growth in consumption per adult equivalent in the survey (6.5%). As a result, the difference between the GDP per capita changes and simulated mean consumption changes in each year is small.

In general, use of a large number of quantiles will cause the simulated distribution in the final year to more closely match that in the final survey year data. However, when using weighted data, complications may arise that force the use of a smaller number of quantiles. The simulation requires that at least one household be associated uniquely with each quantile. Because the quantiles are calculated by individual, with weighted data a household may be classified as being in two adjacent quantiles, even though the number of households exceeds the number of quantiles. If this is the case, a smaller number of quantiles should be used. For the analysis in this paper, 50 quantiles are used.

4.3 Reconciling National Accounts and Household Survey Data

The approach taken in this paper is to apply per capita GDP growth rates from the national accounts data to unit-record household survey data to simulate changes in household per capita consumption. This approach assumes some correspondence between the micro-level household data and the macro national accounts data. Because the two sets of data are drawn from entirely different sources and are designed to capture different phenomena, it is to be expected that the match-up between the two sources of data is rough at best.

In general, it is often difficult or impossible to reconcile differences between the national accounts and household survey data. As Ravallion (2003) says in a review of comparisons between national accounts (NAS) and survey data, "It is evident that when the levels or growth rates from these two data sources differ, there can be no presumption that the NAS is right and the surveys are wrong, or vice versa, since they are not really measuring the same thing, and both are prone to errors."

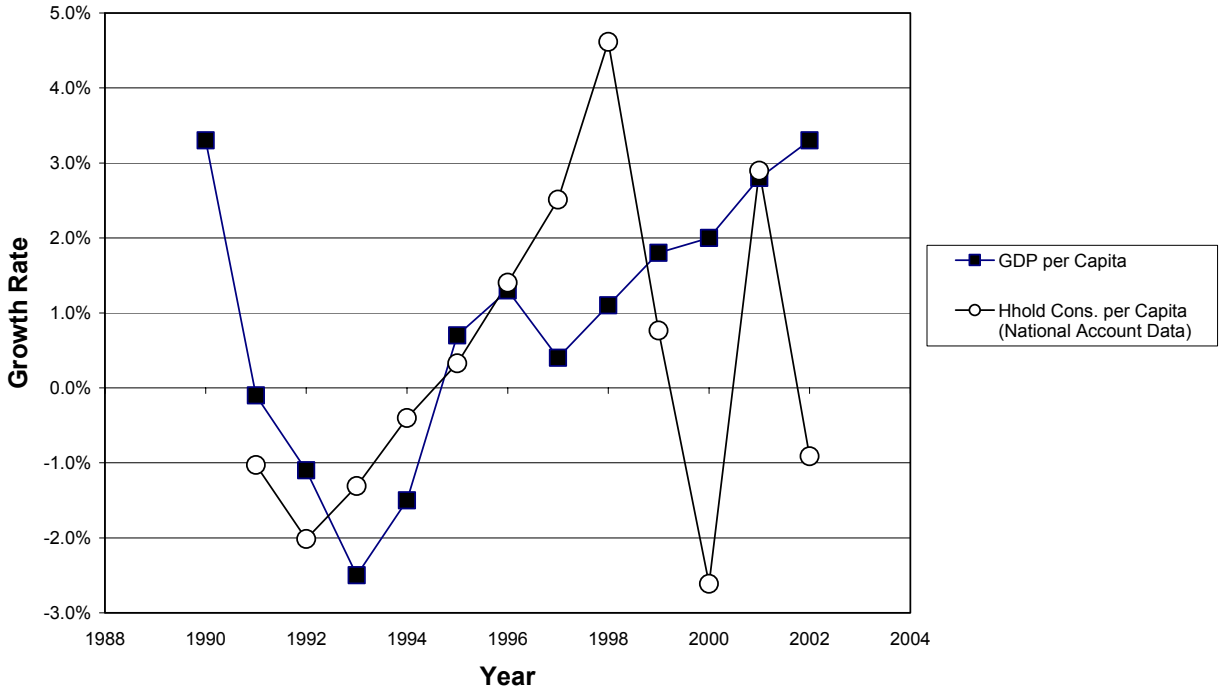
In terms of growth rates in Tanzania for the period between the household surveys (1993-2001), there is surprisingly good correspondence between the HBS data and the national accounts. The cumulative GDP per capita growth of 6.1% is very close to the 6.5% growth in consumption per adult equivalent in the household survey. This close match between the general picture painted by the micro and macro data provides support for the validity of the simulation exercise undertaken for this paper.

It is also possible to calculate the growth rate of per capita consumption directly from the national accounts data. Figures from these calculations are shown in the last column of Table 2 and are plotted in Figure 3 below, along with the GDP per capita growth rate figures. At 8.3%, the cumulative change in per capita household consumption is only slightly larger than the cumulative change in per capita GDP. Mathematically, this is because household consumption changed just slightly, from 90% to 91% of GDP, between 1993 and 2001.

While details on the particular methodology used to develop the Tanzania national accounts data are not available, typically consumption figures in national accounts statistics are estimated as a residual in the national income calculation. As a consequence, there is great uncertainty in the estimates, particularly in year-by-year fluctuations. For this reason, growth rates in GDP per capita are used in this paper, except in one variation of the simulation analysis.

Figure 3

Growth Rates of GDP per Capita and Household Consumption per Capita in Tanzania, National Accounts Data



4.4 Sources of Error in the Simulation Analysis

Several sources of error enter the simulation analysis. First, there is the usual sampling error associated with the survey data. Second, there is uncertainty associated with the national accounts growth estimates. Third, there is drift between the national accounts GDP levels and household consumption levels, i.e. the growth rates of the two may not be equal. Fourth, the true year-by-year changes in the distribution of consumption differ from the changes assumed in the simulations. Fifth, the uniform application of national population growth rates to the rural and urban sectors appears inconsistent and sector specific growth rates might be preferable. Of all of these, only sampling error is readily quantifiable, and the associated standard error terms are calculated for all simulated poverty rates. It is important to recognize, however, that these standard errors are only an extreme lower bound for the true error. The fifth source of error, finally, is considered in Section 5.4.

5 Simulation Analysis

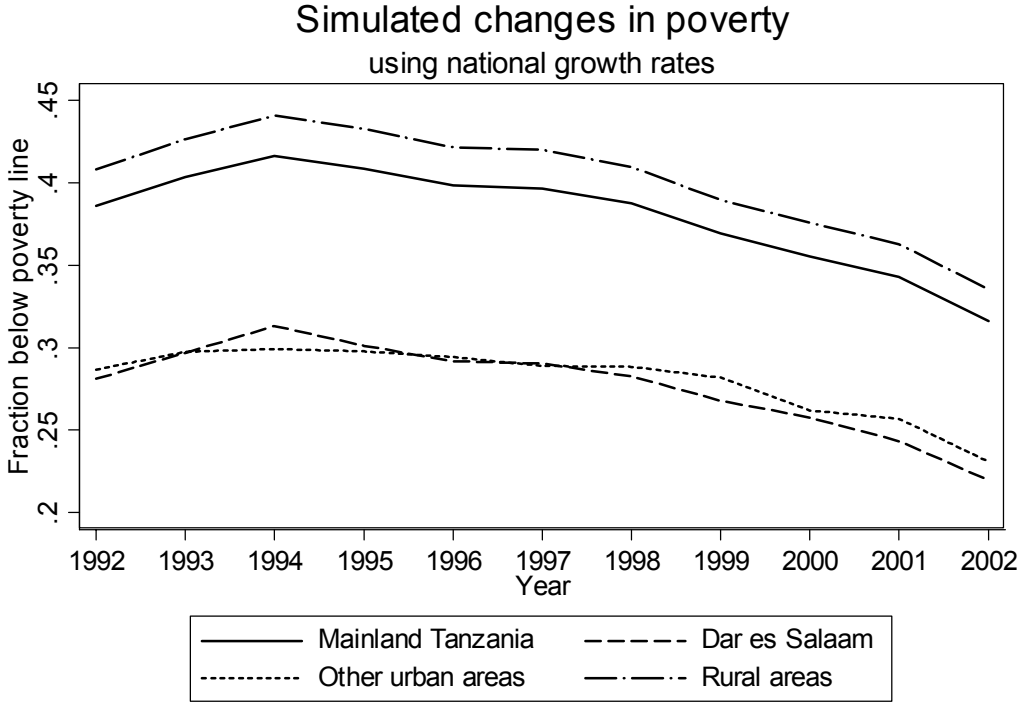
The simulation analysis is conducted under a variety of scenarios, with varying assumptions, first using the Datt and Walker approach and then using the two survey approach. The intent is both to explore the sensitivity of the results to the underlying assumptions applied, and to identify variations which most closely match the change in the distribution of consumption observed between the two surveys.

Note that for all simulations, the 1991/92 HBS data is taken as corresponding to calendar year 1992, and likewise the 2000/01 data is taken as being from 2001. Consequently, the projections apply the annual growth rates starting in 1993, the year following the first survey. The simulations are carried forward one additional year past the second survey, to 2002. An alternative choice would be to assign the two surveys to calendar years 1991 and 2000, respectively, and apply the growth rates from 1992 onwards. Several versions of the analysis (not shown) were run with this assumption, and results were similar.

5.1 Simulation with Uniform National Growth Rates

The simplest version of the analysis is to apply the national GDP per capita growth rates, as shown in Table 2, uniformly to all households. Headcount rates from this simulation are shown in Appendix Table A2 and plotted in Figure 4 below. Poverty levels for the two years corresponding to the surveys, 1992 and 2001, are shown in italics. Headcount rates from the 2000/01 HBS are also appended to the end of table for comparison purposes. The simulated poverty rates for 2001 match the survey data surprisingly well. The survey estimate of 0.357 is well within the confidence interval of the simulated value, 0.343. The simulated headcount rates for "other urban areas" and rural areas also match up well with the survey estimates. This simplest form of the simulation, however, does not reproduce the steeper decline in poverty in Dar es Salaam.

Figure 4



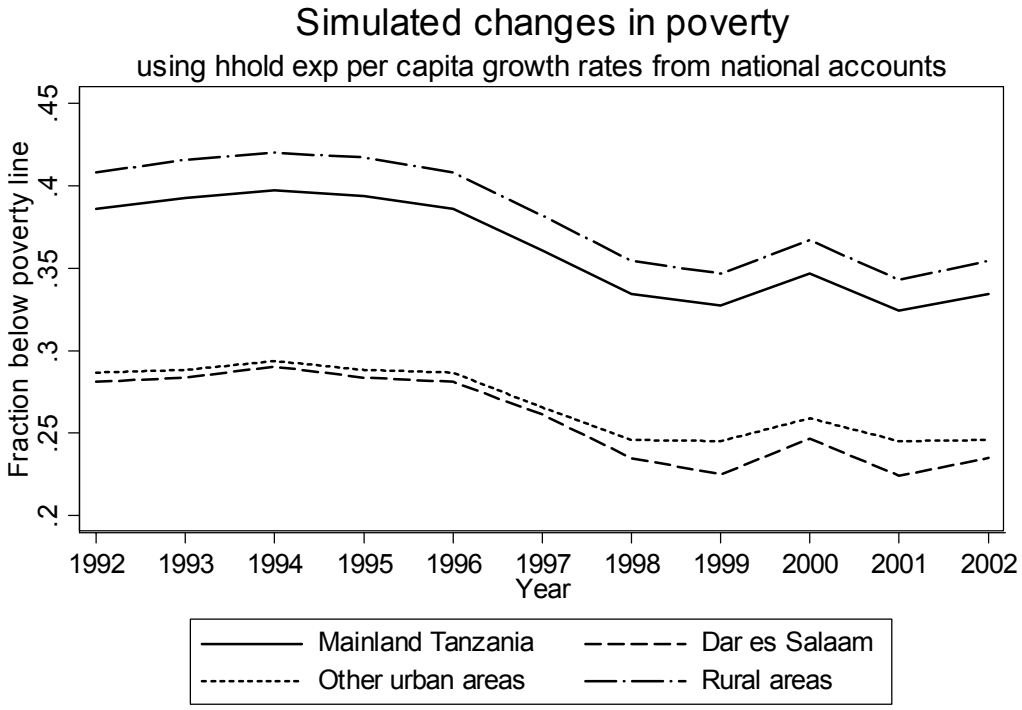
The overall picture shows the inverse of the growth pattern in Tanzania in the decade: declining GDP per capita in the early 90s drove a steep rise in poverty, while the country's improved growth trajectory in more recent years has achieved a steady decline in poverty. With additional versions of the simulation, we can assess the sensitivity of this general pattern to the underlying assumptions. Note that applying uniform growth rates to all households does not imply identical

rates of poverty reduction across rural and urban areas. The simulated rates of poverty reduction are determined by both the growth rate and the distribution of consumption within each of the sectors.

5.2 Simulation Using National Accounts Household Consumption Data

Results from a simulation applying growth rates for household consumption per capita (shown in the last column of Table 2) are displayed in Appendix Table A3 and Figure 5. While the overall pattern is unchanged, applying these growth rates instead of those for GDP per capita implies that rather than dropping fairly steadily since the mid-90s, poverty dropped steeply 1996-98 and has since remained flat. This is due to the fact that, according to the national accounts data, household consumption as a fraction of GDP grew during the mid-90s and then fell at the end of the decade, offsetting the effect of rapid growth.

Figure 5

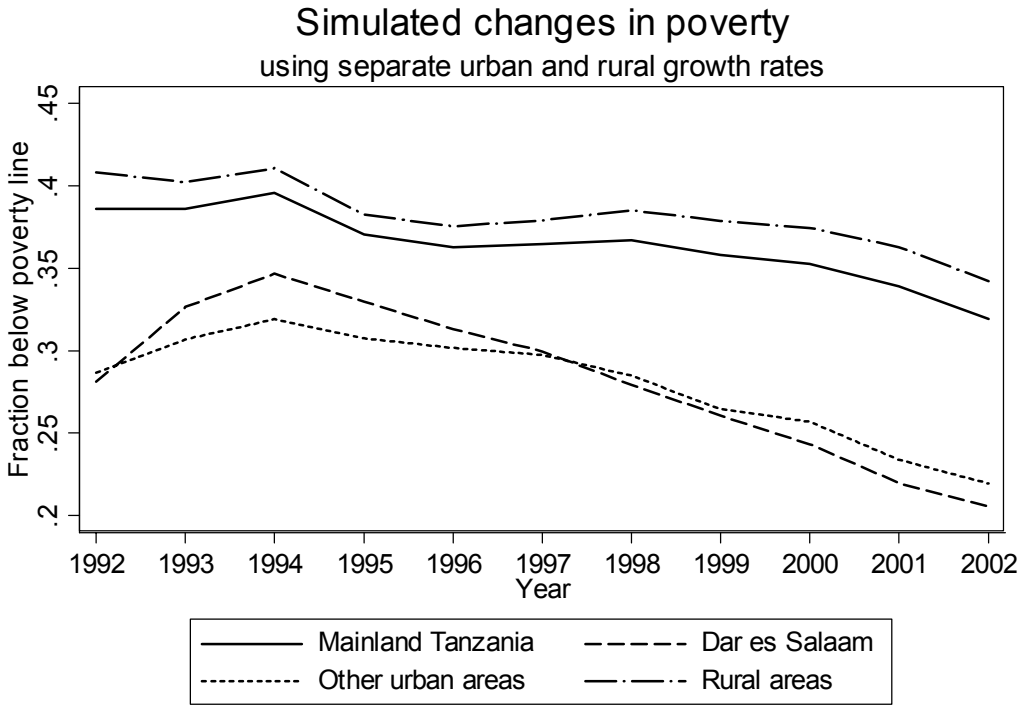


5.3 Simulation with Separate Urban/Rural Growth Rates

Appendix Table A4 and Figure 6 show results from a simulation applying separate urban and rural growth rates, and the national population growth rate of 2.9%. The separate growth rates were calculated from the data in the *Economic Survey 2002* by grouping changes in output by sector; the rural growth rate was calculated as the growth rate of the agricultural sector (monetary and non-monetary), and the total growth of other sectors was taken as the urban growth rate.

The simulated 2001 headcount rates are lower across the board than in the national growth scenario, and in all cases the simulated values fall within the confidence intervals of the estimates from the 2000/01 HBS. While the overall pattern is broadly the same as in the first scenario, this simulation shows a much steeper rise and fall for poverty in Dar es Salaam, and a flatter poverty trajectory in rural areas and the nation as a whole.

Figure 6



5.4 Simulation with Alternative Urban/Rural Population Growth Rates

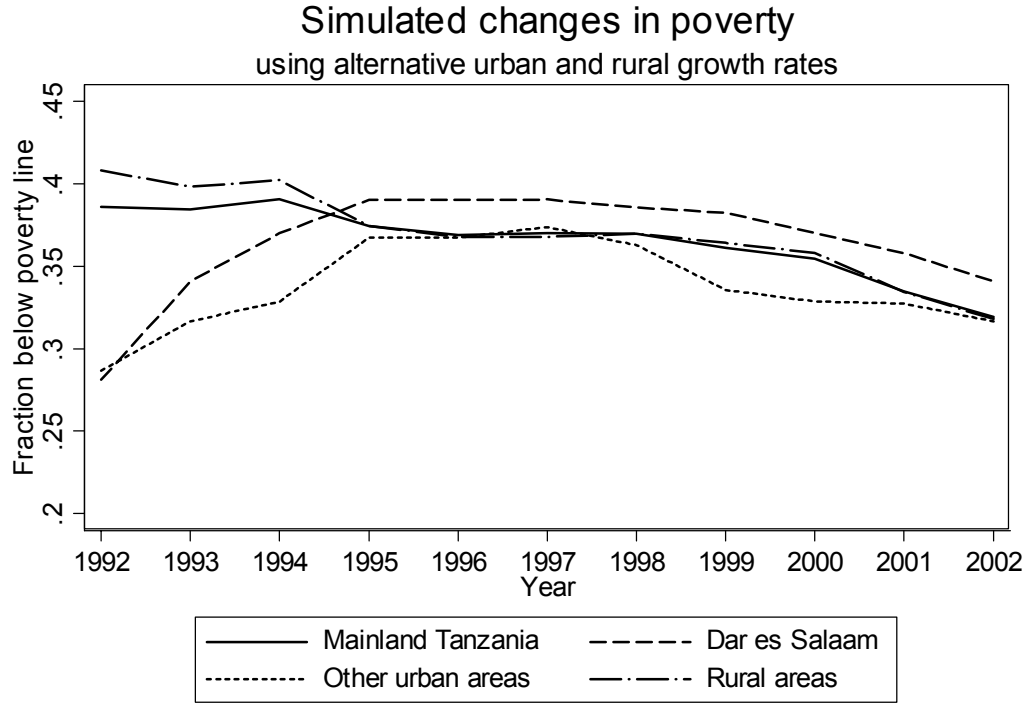
The sectoral (urban/rural) GDP per capita growth rates employed in the previous section are the same as those displayed in Table 2. These were calculated from sectoral GDP figures, assuming a uniform national population growth rate of 2.9%. This population growth rate corresponds to the change in national population between the 1988 and 2002 censuses. Alternatively, we can use sectoral population figures to calculate the per capita growth rates. Annual population growth averaged 4.6% in urban areas and 2.5% in rural areas.

Appendix Table A5 and Figure 7 below display results from a simulation employing these alternative growth rate figures. This simulation fairs much worse than others in terms of matching the true 2002 poverty rates. It shows the rural headcount rate declining to 0.318, far below the true

value of 0.387. For Dar es Salaam, rather than declining to 0.176, the simulation shows poverty rising to more than twice that level, 0.358.

It is unclear why using sectoral population growth rates produces such implausible results. We suspect this is related to population growth assumptions underlying the national accounts data. However, without a detailed understanding of how the national accounts data were constructed, we are unable to say conclusively. For purposes of this paper, we focus on the sectoral per capita growth rates calculated with the *national* population growth rate, on the basis that they provide a much better match to the 2001 survey data.

Figure 7



5.5 Simulation with Regional Growth Rates

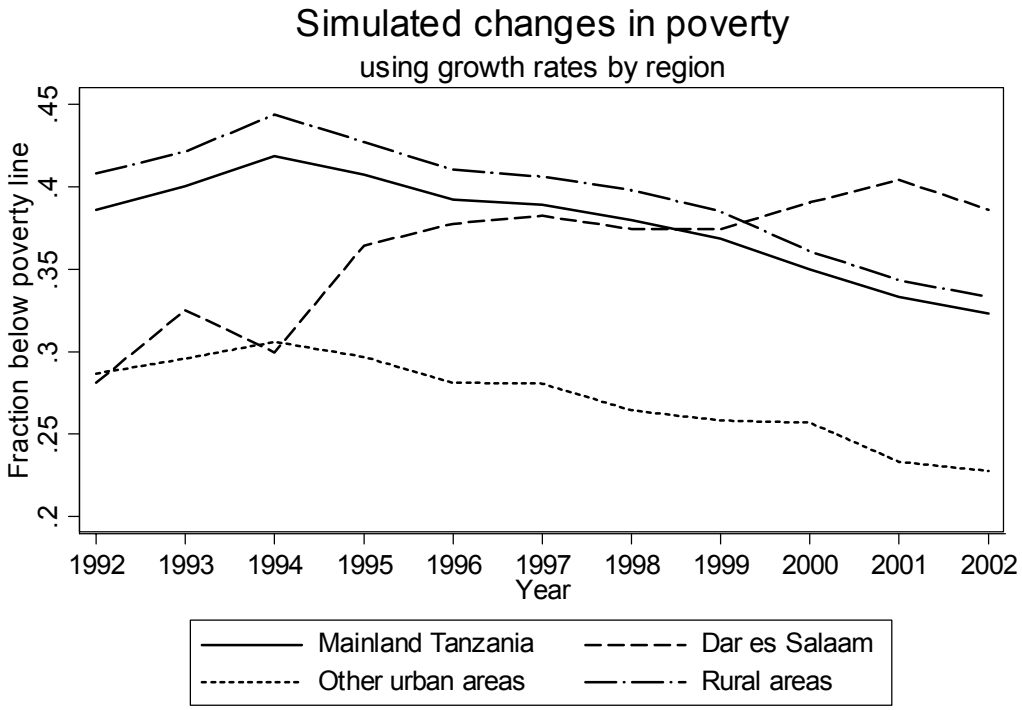
Another alternative is to apply growth data at the regional level, using annual GDP data by region. This data, in current prices, was converted to real values using the GDP deflator in Table 2, and the annual levels were used to calculate regional GDP growth rates for each year. Separately, regional population growth rates were calculated using the regional totals from the 1988 and 2002 national censuses. These regional GDP and population growth rate estimates are shown in Appendix Table A6. Regional GDP per capita growth rates were then calculated year-by-year by subtracting the population growth rates from the GDP growth rates.[8] Population changes were also taken into account to adjust the weights used in the calculation of poverty rates.

Results from this simulation are shown in Appendix Table A7 and in Figure 8 below. The resulting simulation closely tracks the results using only rural/urban growth rates, with the exception

[8] While the regional GDP changes are different values year-by-year, the population growth rate by region is assumed constant over time.

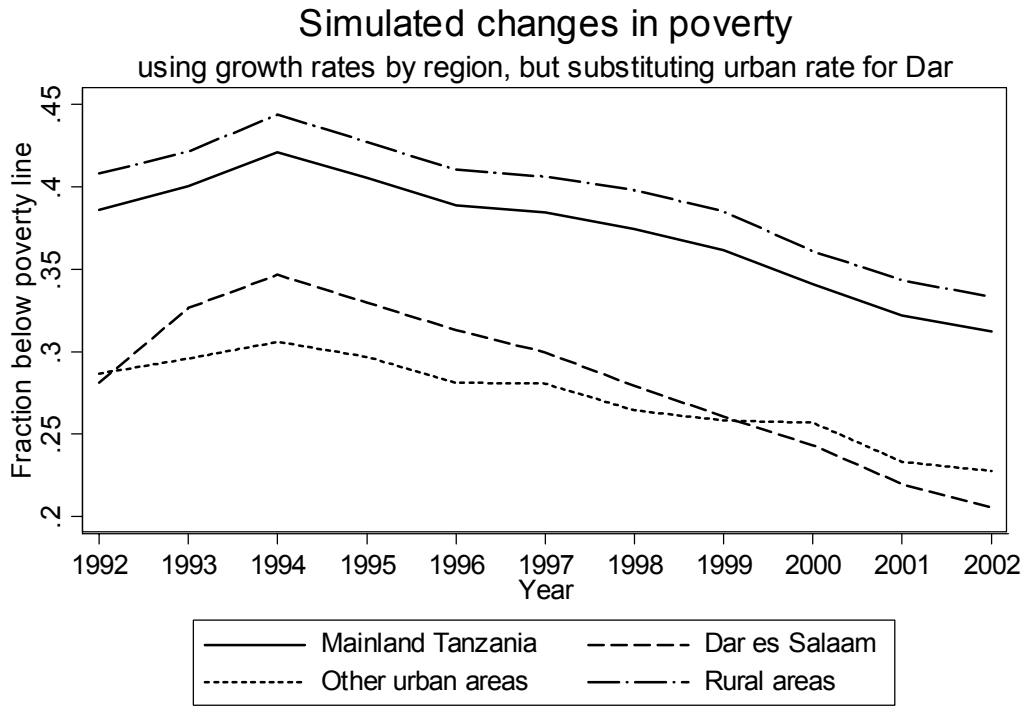
of Dar es Salaam, which is its own region in the regional data. The simulation shows a large increase in poverty in Dar es Salaam, contrary to the decline observed in the survey data.

Figure 8



The simulated poverty increase in Dar es Salaam is the product of a steep decline in GDP per capita in the official figures, which is not compatible with the 43% increase in mean per capita consumption seen in the HBS for the capital. While details of the methodology behind the regional growth data are not available, it appears likely that the regional figures were calculated using approximations from national data. Indeed, the official figures imply that GDP growth rates for Dar are identical with those of 17 other regions (out of 19) in 1999 and with 11 other regions in 2000. Such approximations are unlikely to offer an accurate picture in a rapidly changing region. In Dar, population growth was extremely rapid; figures calculated from the 1988 and 2002 censuses show that population grew at a 4.4% annual rate. As a result, it is likely that the approximations used to calculate regional GDP underestimate the growth of output per capita in Dar. A reasonable alternative is to substitute the overall urban growth rate (used in the simulation described in section 5.3). Appendix Table A8 and Figure 9 below shows results from simulations using regional growth rates, but substituting overall urban growth rates for Dar.

Figure 9



5.6 Simulation with Regional Growth Rates and Inequality Adjustment

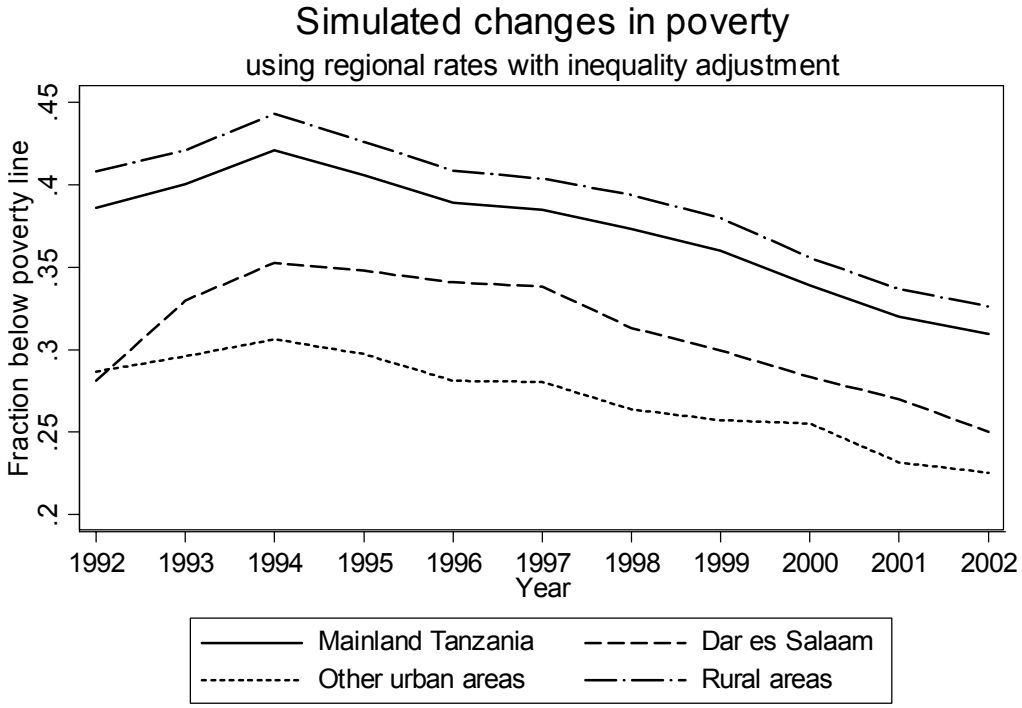
The simulations presented thus far assume that growth was distribution neutral.[9] According to the survey data, inequality jumped up in Dar es Salaam, while remaining essentially unchanged in other urban areas, rural areas, and the country as a whole. The survey data shows that the Gini coefficient for Dar increased from 0.30 to 0.34 between 1992 and 2001.

In this simulation, the inequality adjustment proposed by Datt and Walker (2002) and in Datt et al. (2003) and described in the methodology section is applied by sector (Dar es Salaam, other urban, and rural) in a simulation, using region-specific growth rates. The overall urban growth rate is again substituted for the Dar-specific growth rate. A constant inequality adjustment is applied such that the Gini coefficient in the simulation increases from 0.30 to 0.34 for Dar es Salaam.

Results from this simulation are presented in Appendix Table A10 and Figure 10 below. While the general path of the evolution of poverty is similar, the net drop in poverty in Dar is smaller than that observed in the survey data.

[9] More strictly, the simulation with separate urban-rural growth rates entails the assumption of distribution-neutral growth within each sector, while the simulation with separate regional growth rates used the assumption that growth within each region was distribution-neutral.

Figure 10



5.7 Simulation using "Two Survey" Approach

Finally, simulations were carried out using the "two survey" approach. This was done in two ways. In the first, the national distribution of consumption was used, and national GDP per capita growth rates from the national accounts were applied. In the second, changes in the distributions were simulated separately for each of the three strata: Dar es Salaam, other urban, and rural areas. For this second approach, urban sector national accounts growth rates were used for Dar and other urban areas, while rural sector national accounts growth rates were used for the rural areas stratum.

Results from these two simulations are shown in Appendix Tables A11 and A12, and Figures 11 and 12 below. As expected, the simulated values for 2001 closely match the estimates from the 2000/01 HBS.[10] These simulations show broadly the same patterns as the simulations using the Datt and Walker approach: rising or flat poverty in the initial years, followed by small declines. Unlike the Datt and Walker simulation, these are able to capture the divergence between the rate of declines in poverty in Dar es Salaam and the rest of the country.

Unlike the simulation using the national distribution and national growth rates (Figure 11), the simulation using within stratum distributions and urban/rural growth rates (Figure 12) shows small increases in poverty in 1997 and 1998. This is due to the fact that per capita rural output declined in those two years, even while per capita output for the country as a whole increased.

[10] They do not match exactly because the simulated changes are based on an approximation of the true distributions using 50 quantiles. The maximum number of quantiles used was limited due to issues associated with weighting, as discussed in Section 3.2.

Figure 11

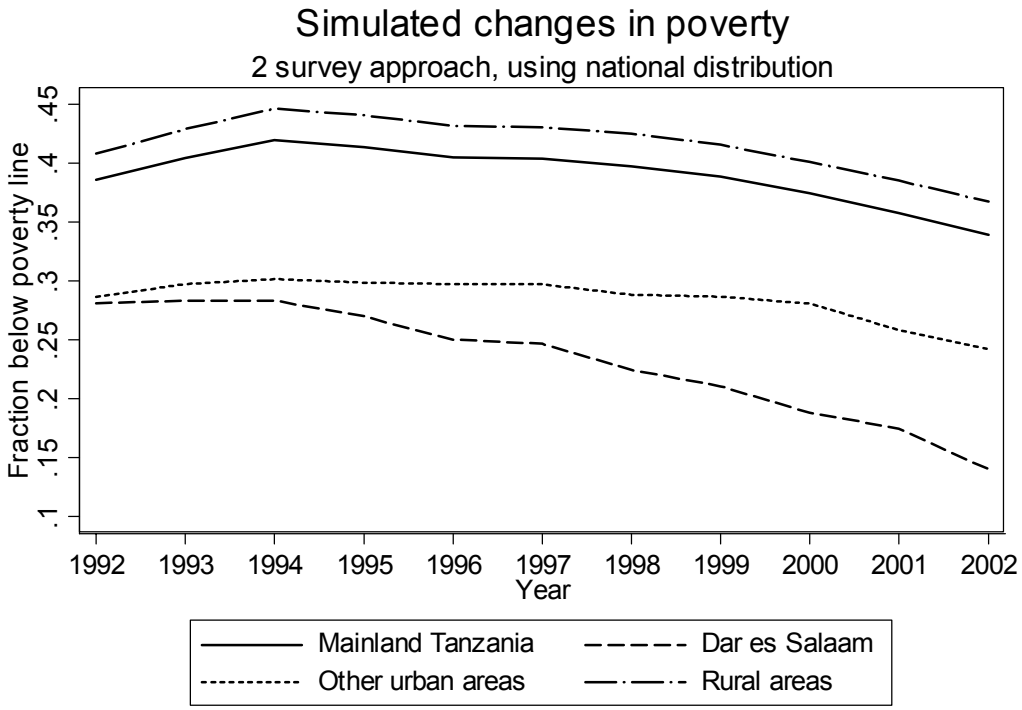
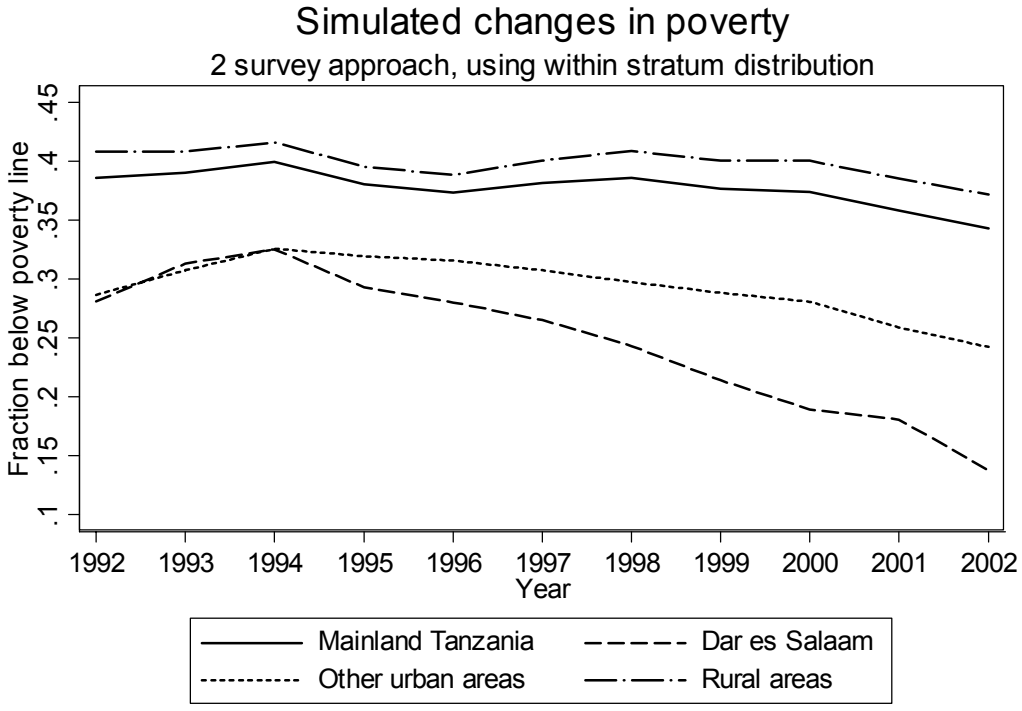


Figure 12



5.8 Did Poverty Decline?

The simulations suggest that poverty declined in Tanzania after 1994. This decline is attributable to the key assumption underlying the simulation approach, that positive per capita GDP growth translates into consumption increases for all population groups (and consequently a reduction in poverty). The appropriateness of this assumption can be scrutinized by investigating the implications of the possibility that poverty did *not* decline. Specifically, if poverty did not decline between 1995 and 2001, while per capita GDP grew at the levels shown in the national accounts, what would the level of inequality had to have been in 1994? The assumption that poverty did not decline would require that all the growth was concentrated among the non-poor, meaning that inequality increased and was therefore lower in 1994 than in 2001.

We consider this scenario by simulating changes backwards from 2001 to 1994, using the 2000/01 HBS data. In this simulation, we set out to keep poverty constant, while adjusting for changes in mean consumption.[11] This can be done by holding consumption constant for those in poverty in 2001 (so that the fraction of poor remains unchanged) and restricting all growth to the non-poor. We also assume that consumption grew at the same rate among those households that experienced some growth.

Note that growth in consumption going backward in time corresponds to reducing consumption. Now consider a household whose consumption in 2001 is just above the poverty line. If we were to reduce its consumption as we move backwards in time, the household would fall below the poverty line and poverty in 1994 would not be identical to poverty in 2001. Through a series of simulation exercises, we find that to keep the level of poverty constant between 2001 and 1994 while adjusting for changes in mean consumption, we must restrict the growth adjustment to those in the top 53% of the consumption distribution in 2001.

With the scenario so defined, we can consider what inequality would have been in 1994 if poverty did *not* decline between 1994 and 2001. Under this scenario, the Gini coefficient for 1994 would have been 0.31, compared to 0.34 in 2001 and 0.33 in 1992. The difference between 0.31 and the values in both 1992 and 2001 is statistically significant.

It is possible but unlikely that inequality would have declined from 0.33 to 0.31 in just two years. This means that the scenario considered--that poverty did not decline at all 1995-2001—is unlikely to have taken place. This provides some further support for the hypothesis that poverty rates followed the inverse-U pattern shown in the simulations.[12]

5.9 Poverty Incidence and the Millennium Development Goals

Finally, we consider how declines in poverty compare with declines that would be needed to meet the Millennium Development Goal target, interpreted here as a reduction by half from 1992 levels in both rural and urban poverty by 2015. Figure 13 shows the simulated poverty trajectories using the two-survey approach based on the stratum-level distributions of consumption.

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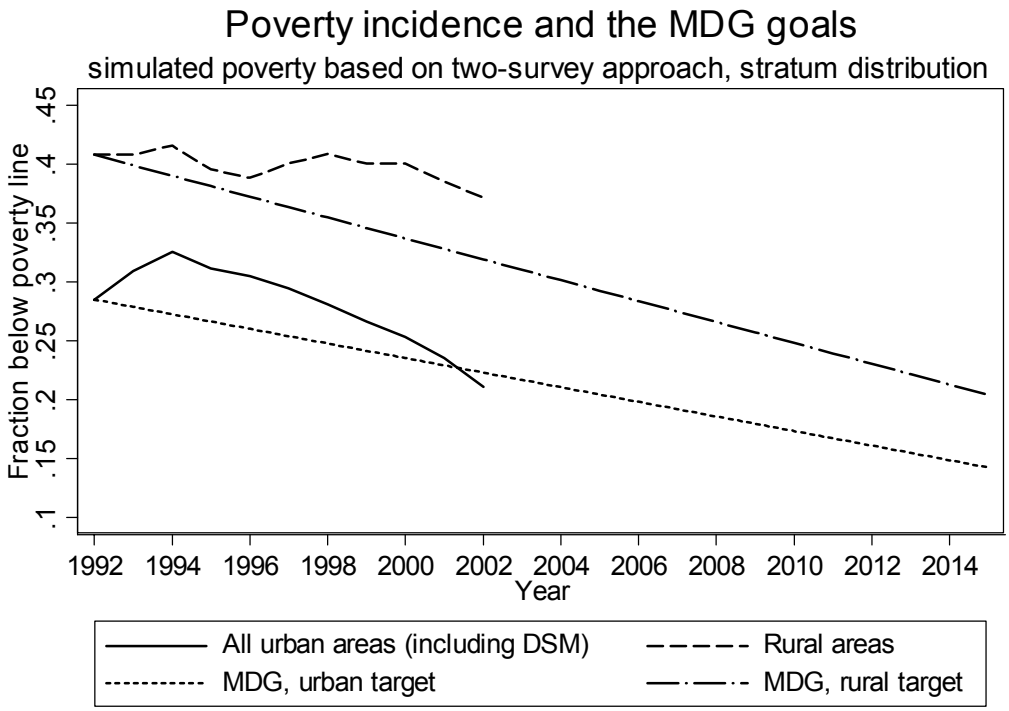
[11] Specifically, the national accounts data shown in Figure 2 imply that per capita GDP in 1994 was equivalent to 90.3 percent of per capita GDP in 2001. We assume, as earlier, that growth in per adult equivalent consumption was equal to growth in per capita GDP.

[12] It is possible to construct scenarios where poverty did not decline 1995-2001 but inequality also remained unchanged. Specifically, this would be the case if growth took place only among middle-income households, while consumption remained constant for both the poor and the rich.

The figure shows that recent growth has brought the urban poverty rate approximately on track to achieve the MDG by 2015. By the interpretation used here, the MDG target urban poverty rate for 2001 was 22.9 percent, while the estimate of the actual value from the 2000/01 HBS survey was 23.3 percent.[13]

Figure 13



The rural poverty rate remains substantially above the path necessary to achieve the MDG target. The MDG target for rural areas is attainable, but it will require sustaining growth at or above the rates achieved in 2001 and 2002. The rural GDP per capita growth rate was 2.6 percent in 2001 and 2.1 percent in 2002. A simulation forward from the 2000/01 HBS data, assuming distribution-neutral growth, implies that the rural poverty reduction target will be met if a rural GDP growth rate of 2.3 percent per capita is maintained through 2015. The estimate of 2.3 percent is a lower bound, assuming no increase in inequality. If future growth is accompanied by increases in inequality, a growth rate greater than 2.3 percent in GDP per capita will be needed to achieve the MDG target. Assuming rural population growth net of migration continues at the rate of 2.5 percent annually and inequality does not increase (the national growth rate 1988-2002), rural GDP growth will need to reach 4.8 percent to achieve the MDG target.

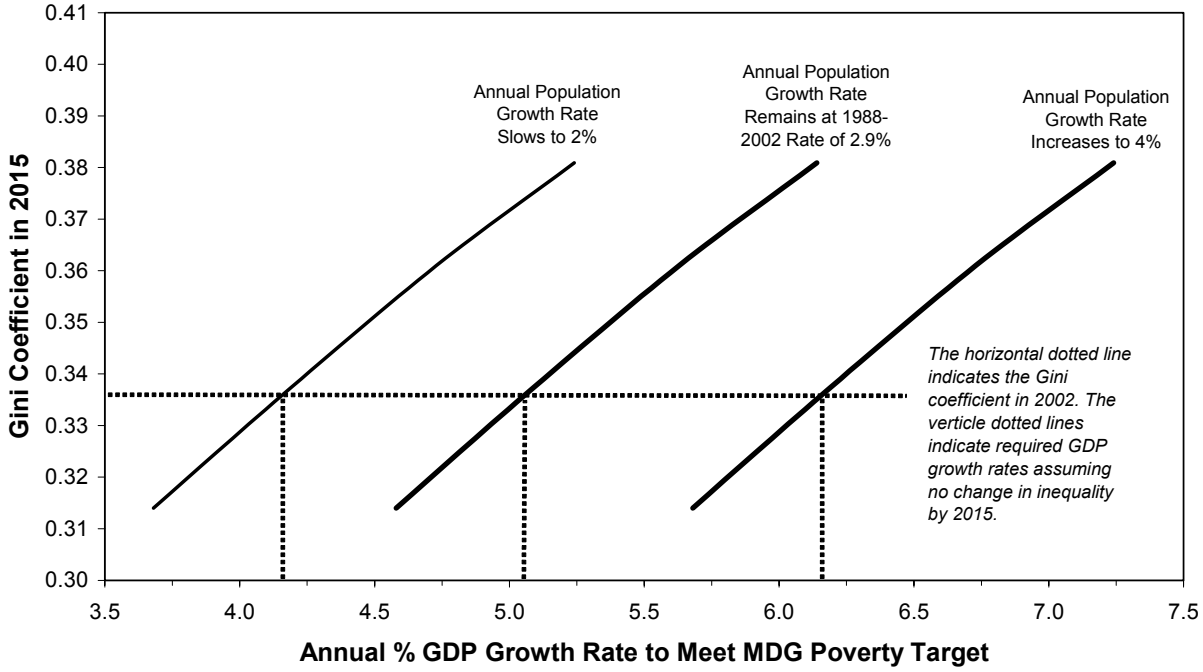
Similarly, a simulation done for the entire country on the basis of a single national growth rate shows that annual GDP growth for the country as a whole will need to reach 5.1 percent to achieve the MDG target, assuming no increase in inequality and no change in the population growth rate. Figure 14 shows the GDP growth rates that would be needed under alternative population growth rates and inequality scenarios. The numbers underlying the figure were calculated from simulations assuming increases in the Gini coefficient in the form outlined in section 4.1. Because

[13] Note that the urban poverty estimate for 2002 which is below the MDG path is from a one-year extension of the simulation, rather than from the HBS survey directly.

the same Gini could be associated with a variety of poverty rates, the particular correspondence here should be taken as suggestive of the general relationship between the Gini, population growth, and GDP growth. The figure illustrates that higher population growth rates or increases in inequality would require a GDP growth rate of above 5.1 percent to achieve the MDG target. Likewise, a lower GDP growth rate could be sufficient to achieve the MDG target if inequality declines or population growth slows.[14]

Figure 14

GDP Growth Rates Needed to Meet 2015 Millennium Development Goal Target for Poverty Reduction in Tanzania Under Various Inequality and Population Growth Rate Scenarios



[14] The effect of changes in inequality on the GDP per capita growth rate needed to achieve a particular poverty rate is described by a simple formula. We assume that growth consists of a combination of distribution-neutral growth and a mean-neutral change in inequality of the form outlined in section 4. Define the following notation: n is the number of years between the final and initial years, G_F is the Gini coefficient in the final year, G_0 is the Gini coefficient in the initial year , $c_{povline}$ is the poverty line, $\bar{c}_0$ is mean consumption in the initial year, and c_X is the consumption in the initial year of the household at percentile X, where X is the target headcount. The annual per capita GDP growth rate necessary to achieve X is the following: $\left[\frac{c_{povline}}{c_X - \frac{(G_F - G_0)(\bar{c}_0 - c_X)}{G_0}}\right]^{1/n} - 1$.

6 Conclusions

The starting point for the analysis in this paper was the observation that despite rapid growth in per capita GDP in the late 1990s, survey data shows that the drop in poverty nationally between 1992 and 2001 was small. A plausible explanation for this pair of facts is that poverty first increased during the period of economic stagnation that ended in 1995 and only declined once rapid growth was achieved in the second half of the decade. Consequently, recent growth has reduced poverty, even though the change observed between the two surveys shows only a small net drop in the fraction who are poor.

The simulated poverty trajectories in this paper support this view. Under a variety of scenarios, the simulations imply that poverty rates have followed an inverted U-pattern, increasing to over 40% or higher in 1994 and then dropping, down to below 36% in the 2000/01 survey. Variations of the analysis which take into account separate urban-rural growth rates show small increases in rural poverty in 1997 and 1998, when rural per capita income declined while urban per capita output grew, followed by declining rural poverty.

We employ both the Datt-Walker macro-micro projection technique and a modified "two survey" version of their method. In the Datt-Walker analysis there are instances where growth patterns diverged substantially from the general pattern. These are the simulations using Dar-specific growth data, aggregate household consumption estimates from the national accounts, and alternative urban/rural population growth rates. In all three cases, it is likely that the results are the consequence of rough approximations in the national accounts data.

In most cases, relative to the survey estimates, the simulations with the Datt and Walker method overestimate drops in poverty in rural areas and the nation as a whole, while underestimating the drop in poverty in the capital. This reflects the particular distributional incidence of growth (in the survey data) which is illustrated by the growth incidence curves. Our modified "two survey" method provides a close match between the simulation and the final year survey data, irrespective of the particular distributional incidence of growth. Consequently, we take the two versions of the analysis using this method (Figures 12 and 13) as our preferred simulated poverty trajectories.

We also presented some supporting evidence that suggests it is very likely that poverty declined since 1994. The alternative hypothesis—that poverty has *not* declined—would require that inequality dropped significantly from 1992 to 1994.

It is important to recognize that the precision and accuracy of the presented results is only as good as the underlying data. Uncertainty is associated with the macro data, the micro data, and the assumptions that go into the simulation analysis. Only the sampling error arising from the household survey can be readily quantified, and the standard errors on the survey-based estimates provide an extreme lower bound on the standard errors on the simulated poverty rates. This suggests that the year-to-year pattern of changes in poverty may differ substantially from what is implied by the simulations. Nonetheless, the analysis presented here provides the best estimates of poverty rate trajectories in Tanzania with available data.

In terms of the Millennium Development Goal of cutting poverty in half by 2015, growth at the end of the last decade has put Tanzania roughly on the path necessary to meet the goal for urban areas. This is despite the fact that the poverty-reducing impact of growth has been partly offset by increasing inequality, particularly within Dar es Salaam. Rural areas, where the large majority of Tanzanians live, are lagging behind their MDG target.

Reaching the MDG goal for poverty reduction by 2015 will require sustaining and improving upon the rural growth rates achieved in recent years. Given that only a tiny minority of the population lives in the capital, even rapid urban growth will have only a small impact on poverty in

the nation as a whole. Tanzania needs strong growth in rural output per capita to make a substantial dent in the national poverty rate and attain the national poverty MDG. This requires sustained growth in rural GDP, a reduction in the rate of population increase or a combination of both.

7 References

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Appendix Simulation with Regional Poverty Rates Backwards from 2001 Data

The analysis presented thus far involves simulating changes in poverty forwards from the 1991/92 survey data. Although Datt and Walker do not discuss the possibility in their work, it is also possible to project changes *backwards* from the 2000/01 data. In terms of the notation used in Section 4, this involves recursive calculations for household consumption and the weights as follows:

$$(12) \qquad c_{i,t-1} = \frac{c_{i,t}}{(1 + g_t^{S_i} - \eta_t^{S_i})},$$

and

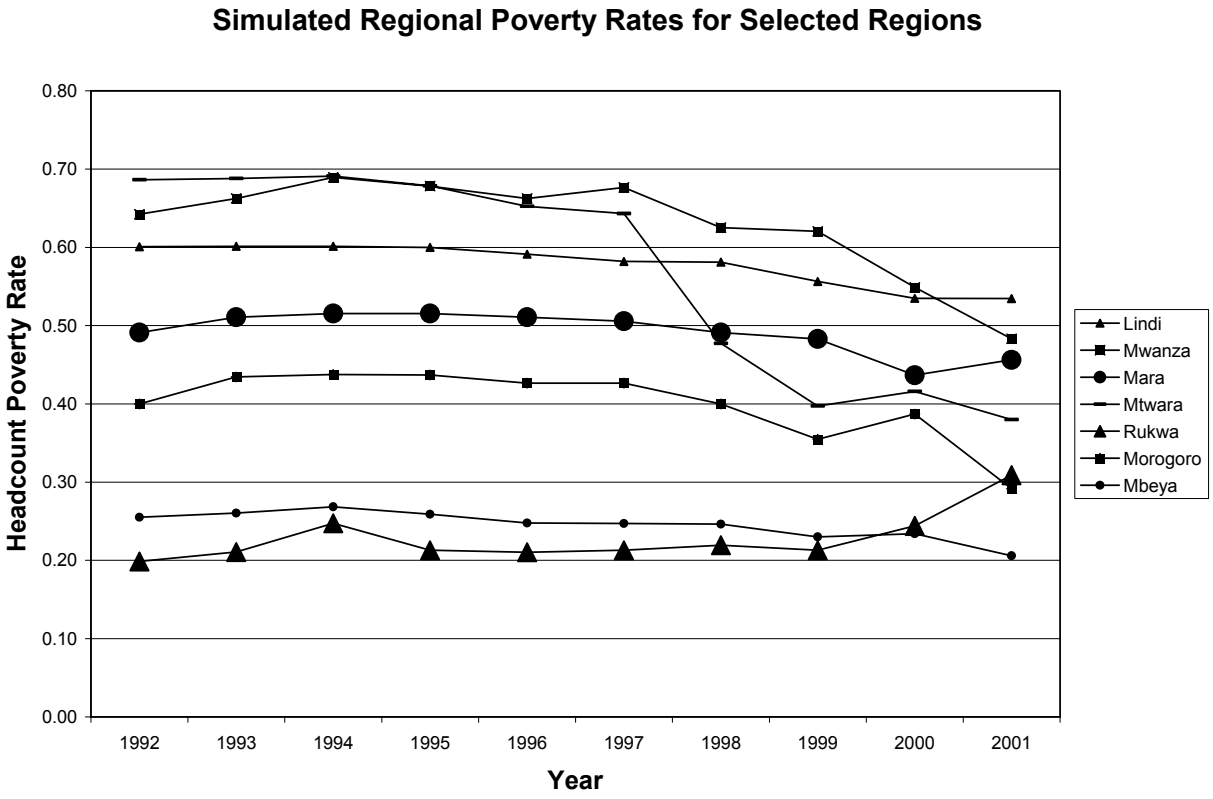
$$(13) \qquad w_{i,t-1} = \frac{w_{i,t}}{(1 + \eta_t^{S_i})}.$$

For Tanzania, the backwards analysis has one advantage over the forward analysis. Because the 2000/01 HBS is representative at the regional level, regional poverty rates going back in time can be simulated. The earlier HBS is only representative at the stratum level, so it cannot be used to produce region-level estimates.

Year-by-year simulated headcount rates at the regional level are shown in Appendix Table A9, and headcount trajectories are plotted for a sample of regions in A1. The table also shows the standard errors on the 2001 estimates, which are calculated from the actual survey data. Overall, most but not all regions show a pattern mirroring that of changes in the national poverty rate: increases in poverty in the first part of the decade followed by declines in recent years.

These regional poverty rates should be interpreted with great care. In addition to the caveats already mentioned, the standard errors on the regional predictions are large because the regional sample sizes are small. As discussed in the previous section, growth estimates for some regions in certain years (in particular 1999 and 2000) appear to have been obtained by very rough approximations based on national growth rates. In Mtwara, simulated poverty incidence drops at an implausible rate, from 64% in 1997 to 40% in 1999. As there is no baseline with which to compare the results of the regional predictions, it is very difficult to assess their accuracy. There is one region for which this can be done, Dar es Salaam. The backwards simulation implies that the headcount rate for Dar was 10.0% in 1992, while according to the 1991/92 HBS survey it was 28.1% Given the wide divergence between poverty incidence based on regional growth data and the HBS data , the regional results should be taken as broadly suggestive rather than indicative of particular regional trends.

Figure A1


Simulated Regional Poverty Rates for Selected Regions
Headcount Poverty Rate
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Year
Lindi
Mwanza
Mara
Mtwara
Rukwa
Morogoro
Mbeya

Appendix Tables

Appendix Table A1: Published Poverty Statistics

	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
% Below Basic Needs Pov. Line				
1991/92	38.6	28.1	28.7	40.8
2000/01	35.7	17.6	25.8	38.7
Consumption per Capita				
Mean, 1991/92	8686	14896	12733	7661
Mean, 2000/01	10120	21949	14377	8538
Ratio (00/01) to (91/92)	1.17	1.47	1.13	1.11
Gini Coefficient				
1991/92	0.34	0.30	0.35	0.33
2000/01	0.35	0.36	0.36	0.33

Source: *Household Budget Survey 2000/01, United Republic of Tanzania National Bureau of Statistics*

Notes: All figures shown are as published in the HBS report. Poverty lines were calculated on a per adult equivalent basis.1991/92 per capita consumption are given in 2000/01 prices, calculated using not the consumer price index but a Fisher Ideal price index calculated using price data in the HBS itself. The Fisher index implies that an average consumption basket increased in price by a factor of 2.49 between the surveys.

Appendix Table A2: Simulated Headcount Rates, Using Uniform Nation Growth Rate

Year	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
1992 (HBS)	*0.386*	*0.281*	*0.287*	*0.408*
	(0.021)	*(0.028)*	*(0.050)*	*(0.024)*
1993	0.403	0.297	0.297	0.427
1994	0.416	0.313	0.299	0.441
1995	0.409	0.301	0.298	0.433
1996	0.399	0.292	0.294	0.422
1997	0.397	0.290	0.289	0.420
1998	0.388	0.283	0.288	0.410
1999	0.369	0.268	0.282	0.390
2000	0.355	0.258	0.262	0.376
2001	*0.343*	*0.243*	*0.257*	*0.363*
2002	0.316	0.220	0.231	0.335
2001 (HBS)	*0.357*	*0.176*	*0.258*	*0.387*
	(0.016)	*(0.027)*	*(0.022)*	*(0.020)*

Distributions were simulated going forwards, taking the initial distribution from the 1991/92 HBS survey data.
Estimates from the 2000/01 HBS are shown for comparison purposes.
Estimates from Household Budget Surveys are shown with standard errors in parentheses.

Appendix Table A3: Simulated Headcount Rates, Using National Growth Rate, Household Consumption Growth Rates from National Accounts

Year	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
1992 (HBS)	*0.386*	*0.281*	*0.287*	*0.408*
	(0.021)	*(0.028)*	*(0.050)*	*(0.024)*
1993	0.393	0.284	0.288	0.416
1994	0.397	0.290	0.294	0.420
1995	0.394	0.284	0.288	0.417
1996	0.386	0.281	0.287	0.408
1997	0.361	0.261	0.266	0.382
1998	0.334	0.235	0.246	0.355
1999	0.327	0.225	0.245	0.347
2000	0.347	0.247	0.259	0.367
2001	*0.324*	*0.224*	*0.245*	*0.343*
2002	0.334	0.235	0.246	0.355
2001 (HBS)	*0.357*	*0.176*	*0.258*	*0.387*
	(0.016)	*(0.027)*	*(0.022)*	*(0.020)*

Distributions were simulated going forwards, taking the initial distribution from the 1991/92 HBS survey data.
Estimates from the 2000/01 HBS are shown for comparison purposes.
Estimates from Household Budget Surveys are shown with standard errors in parentheses.

Appendix Table A4: Simulated Headcount Rates, Using Separate Urban/Rural Growth Rates

Year	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
1992 (HBS)	*0.386*	*0.281*	*0.287*	*0.408*
	(0.021)	*(0.028)*	*(0.050)*	*(0.024)*
1993	0.386	0.327	0.307	0.402
1994	0.396	0.347	0.319	0.411
1995	0.370	0.330	0.308	0.383
1996	0.363	0.313	0.302	0.375
1997	0.365	0.300	0.297	0.379
1998	0.367	0.279	0.285	0.385
1999	0.358	0.261	0.265	0.379
2000	0.353	0.243	0.257	0.375
2001	*0.339*	*0.220*	*0.234*	*0.363*
2002	0.319	0.206	0.219	0.342
2001 (HBS)	*0.357*	*0.176*	*0.258*	*0.387*
	(0.016)	*(0.027)*	*(0.022)*	*(0.020)*

Distributions were simulated going forwards, taking the initial distribution from the 1991/92 HBS survey data.
Estimates from the 2000/01 HBS are shown for comparison purposes.
Estimates from Household Budget Surveys are shown with standard errors in parentheses.

Appendix Table A5: Simulated Headcount Rates, Using Alternative Urban/Rural Growth Rates

Year	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
1992 (HBS)	*0.386*	*0.281*	*0.287*	*0.408*
	(0.021)	*(0.028)*	*(0.050)*	*(0.024)*
1993	0.385	0.341	0.317	0.398
1994	0.391	0.370	0.329	0.402
1995	0.374	0.390	0.367	0.375
1996	0.369	0.390	0.367	0.368
1997	0.370	0.391	0.374	0.368
1998	0.370	0.386	0.363	0.370
1999	0.361	0.382	0.336	0.364
2000	0.355	0.370	0.329	0.358
2001	*0.335*	*0.358*	*0.327*	*0.334*
2002	0.319	0.341	0.317	0.318
2001 (HBS)	*0.357*	*0.176*	*0.258*	*0.387*
	(0.016)	*(0.027)*	*(0.022)*	*(0.020)*

Distributions were simulated going forwards, taking the initial distribution from the 1991/92 HBS survey data.
Estimates from the 2000/01 HBS are shown for comparison purposes.
Estimates from Household Budget Surveys are shown with standard errors in parentheses.
The per capita growth rates underlying this simulation were calculated on the basis of separate urban/rural population growth rates.

Appendix Table A6: Regional Real GDP and Population Growth Rate Estimates

	Regional Real GDP Growth Rates										Regional Population Growth Rates
Region	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**1988-2002**
Dodoma	0.011	0.014	0.032	0.041	0.039	0.026	0.045	0.016	0.084	0.070	0.023
Arusha	-0.002	0.006	0.082	0.045	0.030	0.017	0.045	0.068	0.061	0.070	0.040
Kilimanjaro	0.003	0.017	0.031	0.041	0.033	0.034	0.045	0.016	0.051	0.055	0.016
Tanga	-0.004	0.019	0.026	0.041	0.031	0.039	0.045	0.081	0.110	0.055	0.018
Morogoro	-0.006	0.009	0.038	0.046	0.025	0.040	0.045	0.016	0.138	0.060	0.026
Pwani	0.014	0.038	0.012	0.030	0.043	0.030	0.045	0.016	0.023	0.045	0.024
Dar es Salaam	-0.002	0.061	-0.025	0.024	0.042	0.051	0.045	0.016	0.028	0.069	0.044
Lindi	0.013	0.014	0.039	0.041	0.033	0.027	0.045	0.016	0.024	0.045	0.015
Mtwara	0.011	0.008	0.047	0.043	0.030	0.334	0.108	0.003	0.080	0.047	0.017
Ruvuma	0.010	-0.004	0.060	0.048	0.026	0.025	0.045	0.015	-0.073	0.050	0.026
Iringa	-0.004	-0.003	0.052	0.050	0.022	0.036	0.045	0.016	0.096	0.065	0.016
Mbeya	0.006	-0.006	0.059	0.049	0.025	0.028	0.045	0.016	0.098	0.065	0.024
Singida	0.010	0.005	0.042	0.046	0.035	0.026	0.045	0.016	-0.032	0.046	0.023
Tabora	0.010	0.006	0.043	0.045	0.034	0.026	0.045	0.016	-0.010	0.050	0.037
Rukwa	0.008	-0.018	0.077	0.054	0.020	0.024	0.045	0.016	-0.046	0.048	0.036
Kigoma	0.015	0.017	0.036	0.037	0.037	0.025	0.045	0.016	0.104	0.050	0.049
Shinyanga	0.006	-0.014	0.066	0.053	0.026	-0.041	0.045	0.131	0.051	0.070	0.034
Kagera	0.011	0.010	0.040	0.043	0.034	0.027	0.045	0.092	0.028	0.052	0.032
Mwanza	0.005	-0.008	0.059	0.050	0.026	0.098	0.045	0.165	0.184	0.079	0.033
Mara	0.010	0.019	0.026	0.039	0.040	0.029	0.045	0.150	-0.042	0.050	0.027

Regional real GDP growth rate estimates were calculated based on nominal GDP level data.
Nominal values were converted to real values using an implicit GDP price deflator calculated using data in *Economic Survey 2002*.
The GDP price deflator was calculated by dividing nominal GDP at factor cost prices (Table 2B) by GDP in 1992 prices (Table 3).
Regional population growth rates are average annual rates, calculated on the basis of regional totals in the
1988 and 2002 national censuses.

Appendix Table A7: Simulated Headcount Rates, Using Regional Growth Rates

Year	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
1992 (HBS)	*0.386*	*0.281*	*0.287*	*0.408*
	(0.021)	*(0.028)*	*(0.050)*	*(0.024)*
1993	0.400	0.325	0.296	0.421
1994	0.419	0.300	0.306	0.444
1995	0.407	0.364	0.297	0.427
1996	0.392	0.378	0.281	0.410
1997	0.389	0.382	0.281	0.406
1998	0.380	0.374	0.264	0.398
1999	0.369	0.374	0.258	0.385
2000	0.350	0.391	0.257	0.361
2001	*0.333*	*0.404*	*0.233*	*0.343*
2002	0.323	0.386	0.228	0.333
2001 (HBS)	*0.357*	*0.176*	*0.258*	*0.387*
	(0.016)	*(0.027)*	*(0.022)*	*(0.020)*

Distributions were simulated going forwards, taking the initial distribution from the 1991/92 HBS survey data.
Estimates from the 2000/01 HBS are shown for comparison purposes.
Estimates from Household Budget Surveys are shown with standard errors in parentheses.

Appendix Table A8: Simulated Headcount Rates, Using Regional Growth Rates, Urban Rate for Dar es Salaam

Year	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
1992 (HBS)	*0.386*	*0.281*	*0.287*	*0.408*
	(0.021)	*(0.028)*	*(0.050)*	*(0.024)*
1993	0.400	0.327	0.296	0.421
1994	0.421	0.347	0.306	0.444
1995	0.405	0.330	0.297	0.427
1996	0.389	0.313	0.281	0.410
1997	0.384	0.300	0.281	0.406
1998	0.374	0.279	0.264	0.398
1999	0.362	0.261	0.258	0.385
2000	0.341	0.243	0.257	0.361
2001	*0.322*	*0.220*	*0.233*	*0.343*
2002	0.312	0.206	0.228	0.333
2001 (HBS)	*0.357*	*0.176*	*0.258*	*0.387*
	(0.016)	*(0.027)*	*(0.022)*	*(0.020)*

Distributions were simulated going forwards, taking the initial distribution from the 1991/92 HBS survey data.
Estimates from the 2000/01 HBS are shown for comparison purposes.
Estimates from Household Budget Surveys are shown with standard errors in parentheses.

Appendix Table A9: Simulated Headcount Rates by Region, Based on Backwards Simulation from 2001

Region	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001 (HBS)	Std. Error (2001)
Dodoma	0.42	0.43	0.44	0.43	0.42	0.40	0.40	0.36	0.37	0.34	(0.06)
Arusha	0.39	0.40	0.41	0.39	0.39	0.40	0.40	0.40	0.39	0.39	(0.07)
Kilimanjaro	0.41	0.41	0.41	0.41	0.40	0.38	0.36	0.34	0.34	0.31	(0.06)
Tanga	0.54	0.55	0.55	0.54	0.53	0.51	0.50	0.47	0.41	0.35	(0.06)
Morogoro	0.40	0.43	0.44	0.44	0.43	0.43	0.40	0.35	0.39	0.29	(0.03)
Pwani	0.48	0.48	0.47	0.48	0.48	0.46	0.46	0.45	0.46	0.46	(0.08)
Dar es Salaam	0.10	0.12	0.11	0.13	0.17	0.17	0.15	0.14	0.18	0.18	(0.03)
Lindi	0.60	0.60	0.60	0.60	0.59	0.58	0.58	0.56	0.53	0.53	(0.14)
Mtwara	0.69	0.69	0.69	0.68	0.65	0.64	0.48	0.40	0.42	0.38	(0.04)
Ruvuma	0.38	0.38	0.39	0.38	0.38	0.38	0.38	0.37	0.37	0.41	(0.08)
Iringa	0.44	0.46	0.47	0.45	0.43	0.43	0.41	0.38	0.38	0.29	(0.05)
Mbeya	0.26	0.26	0.27	0.26	0.25	0.25	0.25	0.23	0.23	0.21	(0.05)
Singida	0.53	0.55	0.58	0.55	0.52	0.50	0.50	0.49	0.49	0.55	(0.05)
Tabora	0.19	0.20	0.21	0.21	0.20	0.21	0.21	0.21	0.24	0.26	(0.04)
Rukwa	0.20	0.21	0.25	0.21	0.21	0.21	0.22	0.21	0.24	0.31	(0.04)
Kigoma	0.28	0.29	0.35	0.36	0.36	0.37	0.39	0.40	0.42	0.38	(0.04)
Shinyanga	0.42	0.46	0.53	0.47	0.46	0.47	0.57	0.55	0.45	0.42	(0.07)
Kagera	0.31	0.32	0.32	0.32	0.32	0.32	0.32	0.31	0.29	0.29	(0.09)
Mwanza	0.64	0.66	0.69	0.68	0.66	0.68	0.63	0.62	0.55	0.48	(0.06)
Mara	0.49	0.51	0.52	0.52	0.51	0.51	0.49	0.48	0.44	0.46	(0.08)

Distributions were simulated going backwards taking the final distribution from the 2000/01 HBS survey data.
Simulations are based on regional GDP growth estimates calculated from regional GDP level estimates and regional population growth rates. Regional average population growth rates were calculated using 1988 and 2002 census counts.

Appendix Table A10: Simulated Headcount Rates, Using Regional Growth Rates, Adjusting for Inequality Using Datt-Walker Method

Year	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
1992 (HBS)	*0.386*	*0.281*	*0.287*	*0.408*
	(0.021)	*(0.028)*	*(0.050)*	*(0.024)*
1993	0.401	0.330	0.296	0.421
1994	0.421	0.353	0.306	0.444
1995	0.406	0.348	0.297	0.427
1996	0.390	0.341	0.281	0.410
1997	0.387	0.338	0.281	0.406
1998	0.376	0.313	0.264	0.398
1999	0.364	0.300	0.258	0.385
2000	0.343	0.283	0.257	0.361
2001	*0.325*	*0.270*	*0.233*	*0.343*
2002	0.315	0.250	0.228	0.333
2001 (HBS)	*0.357*	*0.176*	*0.258*	*0.387*
	(0.016)	*(0.027)*	*(0.022)*	*(0.020)*

Distributions were simulated going forwards, taking the initial distribution from the 1991/92 HBS survey data.
Estimates from the 2000/01 HBS are shown for comparison purposes.
Estimates from Household Budget Surveys are shown with standard errors in parentheses.

Appendix Table A11: Simulated Headcount Rates, Two Survey Approach, Using National Distribution

Year	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
1992 (HBS)	*0.386*	*0.281*	*0.287*	*0.408*
	(0.021)	*(0.028)*	*(0.050)*	*(0.024)*
1993	0.405	0.283	0.297	0.429
1994	0.419	0.283	0.302	0.446
1995	0.414	0.270	0.299	0.441
1996	0.405	0.250	0.297	0.432
1997	0.404	0.247	0.297	0.430
1998	0.397	0.225	0.288	0.425
1999	0.389	0.211	0.287	0.416
2000	0.375	0.188	0.281	0.401
2001	*0.358*	*0.175*	*0.258*	*0.385*
2002	0.339	0.140	0.242	0.367
2001 (HBS)	*0.357*	*0.176*	*0.258*	*0.387*
	(0.016)	*(0.027)*	*(0.022)*	*(0.020)*

Distributions were simulated going forwards, taking the initial distribution from the 1991/92 HBS survey data.
Estimates from the 2000/01 HBS are shown for comparison purposes.
Estimates from Household Budget Surveys are shown with standard errors in parentheses.

Appendix Table A12: Simulated Headcount Rates, Two Survey Approach, Using Within Stratum Distribution

Year	Mainland Tanzania	Dar es Salaam	Other urban areas	Rural areas
1992 (HBS)	*0.386*	*0.281*	*0.287*	*0.408*
	(0.021)	*(0.028)*	*(0.050)*	*(0.024)*
1993	0.390	0.313	0.308	0.408
1994	0.400	0.325	0.326	0.416
1995	0.380	0.293	0.319	0.396
1996	0.374	0.280	0.316	0.388
1997	0.382	0.265	0.308	0.401
1998	0.386	0.243	0.297	0.409
1999	0.377	0.214	0.288	0.401
2000	0.374	0.189	0.281	0.401
2001	*0.358*	*0.181*	*0.259*	*0.385*
2002	0.343	0.138	0.242	0.372
2001 (HBS)	*0.357*	*0.176*	*0.258*	*0.387*
	(0.016)	*(0.027)*	*(0.022)*	*(0.020)*

Distributions were simulated going forwards, taking the initial distribution from the 1991/92 HBS survey data.
Estimates from the 2000/01 HBS are shown for comparison purposes.
Estimates from Household Budget Surveys are shown with standard errors in parentheses.